TM11-2084

DEPARTMENT OF THE ARMY TECHNICAL MANUAL

TELEPHONE SWITCHBOARDS SB-55/FTC AND SB-55A/FTC (FIRE REPORTING)

DEPARTMENT OF THE ARMY • NOVEMBER 1949

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DEPARTMENT OF THE ARMY *NOVEMBER 1949*

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TM 11–2084, Telephone Switchboards SB–55/FTC and SB–55A/FTC (Fire Reporting), is published for the information and guidance of all concerned.

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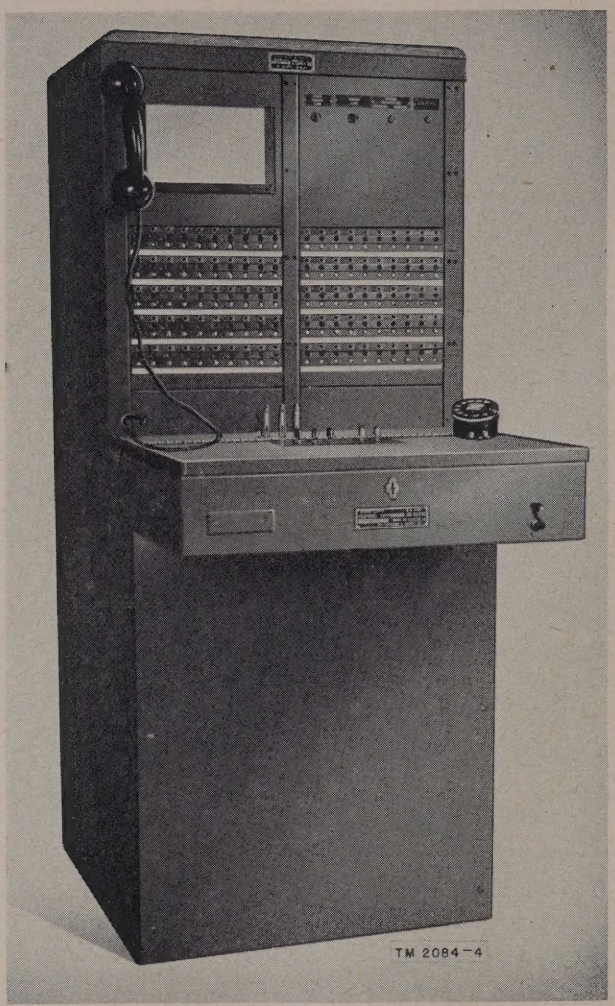


Figure 1. Telephone Switchboard SB–55/FTC. (Telephone switchboard SB–55A/FTC is identical except that it includes a switch located on the upper right front panel for controlling the heater units.).

CHAPTER 1

INTRODUCTION

Section I. GENERAL

1. Scope

a. These instructions are published for the information and guidance of the personnel to whom this equipment is issued. They contain information on operation, organizational maintenance, and field and depot maintenance of the equipment as well as a discussion of theory of operation. They apply to only Telephone Switchboards SB–55/FTC and SB–55A/FTC.

Note.—Telephone Switchboard SB–55A/FTC is identical to the SB–55/FTC except that it includes JAN parts and also contains heating units with an associated switch. Throughout this manual all references applicable to both Telephone Switchboards SB–55/FTC and SB–55A/FTC will be designated as SB–55A(*)/FTC.

b. Paragraph 44 contains copyrighted material from pamphlet EM–1001 Engineering Service Manual No. 2000 Type Relays, copyright 1947. Figures 14 through 27 also consist of copyrighted material. The copyrights on the above items are held by Kellogg Switchboard and Supply Company and are included in this manual with permission.

2. Forms and Records

a. The following forms are used in reporting receipt, operation, and maintenance of the equipment:

(1) NME Form 6 (Report of Damaged or Improper Shipment) for equipment used by the Army will be filled out and forwarded in accordance with AR 700–30—AFR 67–5, when equipment is received in a damaged condition or when it is necessary to report unsatisfactory preservation, packaging, packing, marking, loading, unloading, and handling of supplies.

(2) DA AGO Form 468 (Unsatisfactory Equipment Report) for equipment used by the Army will be filled out and forwarded through channels to the Office of the Chief Signal Officer, Washington 25, D. C., when trouble occurs more often than is normal, as determined by qualified repair personnel.

(3) AF Form 54 (Unsatisfactory Report) for equipment used by the Air Force will be filled out and forwarded to Commanding General, Air Matériel Command, Wright-Patterson Air Force Base, Dayton, Ohio, in accordance with AF Regulation 15–54.

b. Use other forms and records as authorized.

Section II. DESCRIPTION AND DATA

3. General

a. Telephone Switchboard SB–55 (*)/FTC (Fire Reporting) (fig. 1) is a nonmultiple, single position, common battery, manually operated switchboard. Operating on a 48-volt d-c (direct-current) supply, it has a capacity for 100 fixed station lines and 2 trunk lines on a 3-cord circuit providing for two-way signaling and communication over all lines with the operator. The switchboard is 38¼ inches long by 23 15/16 inches wide by 57 3/16 inches high. The equivalent is floor-mounted and classed as fixed station. This switchboard is used for fire reporting as part of a communication system.

b. The switchboard is equipped with the following circuits:

Quantity	*Type of circuit*
100	Common battery manual line circuits.
2	Trunk circuits, dial and CB manual.
3	Cord circuits.
1	Night alarm circuit.
2	Line-out alarm circuits.
1	Operator's circuit.
1	Alarm and ringing circuit.
1	Power-failure alarm circuit.

4. Table of Major Components

a. Equipment Supplied.

Quantity	*Component*
1	Switchboard, telephone.
20	Fuse, open link.
209	Lamp, incandescent, 48 v, 0.035 to 0.045 amp.
209	Lamp, incandescent, 48 v, 0.045 to 0.060 amp.
1	Set of running spares consisting of:
	50 lamp,incandescent, 48 v, 0.035 to 0.045 amp.
	50 lamp, incandescent, 48 v, 0.045 to 0.060 amp.
	1 lamp, incandescent, 120 v, 15 w.
	1 tube, electron (neon lamp).
1	Set of tools consisting of:
	Adjuster, spring (stock No. 6R40067).
	Adjuster, spring (stock No. 6R40060).
	Burnisher, contact.
	Cord, handset.
	Extractor, lamp.
	Handset.
	Pliers, duck-billed type.
	Screw driver.
	Scraper.
	Tool, crimping.
	Wrench, single open-end, 1/8" opening.
	Wrench, socket type, 1/4" opening.
	Wrench, socket type, 7/16" opening.
	Wrench, socket type, 3/8" opening.
	Wrench, socket type, 5/16" opening.
	Wrench, socket type, 7/64" opening.

b. Equipment Required but not Supplied.

Quantity	*Item*
2	Battery BB–232/FTC (storage).
1	Rectifier Battery Charger PP–255/FT.
1	Annunciator ID–214/FT.
1	Distributor Frame TA–47/FT.
1	Ringer TA–48/FT.
1,000 ft	Wire W–122 (cross-connecting).
200 ft	Cable WC–603 (power).
50 ft	Cable, TP, LC, 152 pr.
As required	Telephone TA–105/FTC.

5. Capacity Characteristics

a. Fixed station.

b. Conductor loop resistance not to exceed 700 ohms.

c. 100 line circuits.

d. 2 trunk circuits (dial and CB manual).

e. 3 cord circuits.

f. 48-volt d-c common battery supply to board.

g. Nonmultiple.

Note—This list is for general information only. See appropriate publication for information pertaining to requisition of spare parts.

6. Performance Characteristics

a. Continuous operation.

b. Any specified manner of operating the equipment.

c. Equipment at any ambient temperature in the range of 0 to +55° C.

d. Equipment at any elevation up to 5,000 feet above sea level.

e. Equipment at any relative humidity up to 100 percent.

7. Packaging Data

a. Preservation and Packaging. Preserve and package each Telephone Switchboard SB–55*/FTC in accordance with procedures specified for the designated method as described in specification JAN–P–116 and further described in the following paragraphs. Unless specifically referenced, packaging materials and containers specified should comply with the requirements of the applicable specifications prescribed in specification JAN–P–100.

b. Technical Literature. Package technical literature individually, in accordance with procedure specified for method 1A–9, as follows: Inclose technical literature within a close-fitting type III waterproof bag. Properly seal the closure.

c. Switchboard Lamps (Spare). Insert 10 each spare switchboard lamps within a die-cut chipboard insert, designed to receive the lamps. Place the mounted lamps within a close-fitting suitable style folding carton or set-up box. Overlap the closure with gummed Kraft tape.

d. Electrical Accessories and Spare Parts. Package electrical accessories and spare part items, determined in number and quantities from the current Procurement and Issue Control List, individually, in accordance with the applicable provisions of specification JAN–P–658.

e. Hand Tools. Package hand tools, determined in number and quantities from the current Procurement and Issue Control List, in accordance with the applicable provisions of Army-Navy Joint Packaging Instructions, JPI–12.

f. Consolidated Packages. Consolidate the items packaged as specified in *b* through *g*, within suitable style corrugated fiberboard boxes, having a minimum Mullen test strength of 200 pounds. Fill all voids within the boxes to prevent movement of contents. Seal entire closure with gummed Kraft tape. The net weight of contents

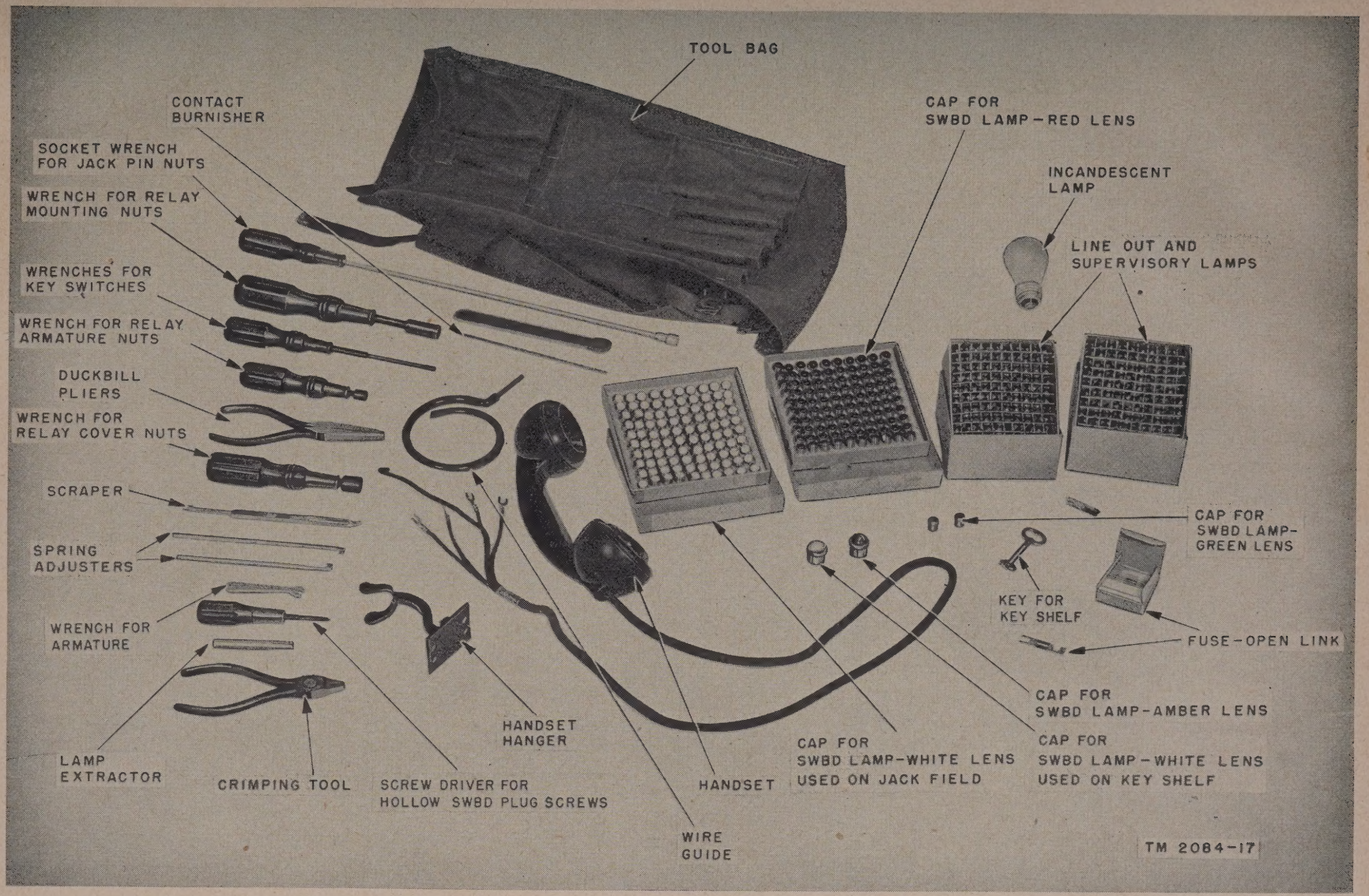


Figure 2. Running spares and tools.

packed within the fiberboard containers should not exceed the allowable loading for the containers specified.

g. Telephone Switchboard SB–55*/FTC. Package each switchboard in accordance with procedures specified for method IIa, as follows:

(1) *Prepackaging switchboard.* Secure the groups of cords with web strapping to the frame members as required to prevent movement or shifting. Block and brace all loose and delicate components mounted within the cabinet by means of felt-covered wooden blocking, and with cells or pads fabricated of corrugated fiberboard. Secure the consolidated package described in *f* above within the switchboard frame. Tie and strap in place with web strapping and cotton tape the interior mechanism as required to reduce shearing stress on the mountings and prevent movement. Design and fabricate wooden blocking frames of neat dimensions to rest on top of and beneath the operator's table. The blocking frames meet the edges of the table on the front and sides, the top frame meets the top edge of the switchboard and the bottom frame meets the bottom edge of the switchboard. Cushion all projecting components on the switchboard with neutral cellulose wadding; secure the cushioning with cotton tape. Completely wrap the switchboard in a blanket of ½-inch thick neutral cellulose wadding, securing the wrapping with pressure-sensitive tape.

(2) *Packaging switchboard.* Design and fabricate a wooden mounting base of adequate size, having a minimum of six bolt holes to receive mounting bolts. Mount the prepared switchboard in operating position on the mounting base, and secure the blocking frames beneath and on top of the operator's table. Securely strap the switchboard to the mounting base in both directions with suitable flat metal strapping. Place ½-inch thick felt pads under all straps, to prevent abrasion. Fabricate the components of a style 2 nailed wooden box conforming to the requirements of specification JAN–P–106, modified to include a skid type base and interior diagonal bracing. Drill matching bolt holes through the skids and base of the box to match bolt holes of the mounting base. Insert suitable style bolts through box skids and base. Assemble in order, waterproof and moisture-vaporproof barriers, gaskets, cushioning shrouds, and over-mounting bolts. Calk around bolts and gaskets with suitable cement. Position mounted switchboard in vertical position over mounting bolts. Place lockwashers over bolts and turn bolt nuts down firmly. Cushion all sharp edges of equipment and blocking assemblies by covering with heavy pads of flexible corrugated paper; secure the padding with gummed Kraft or cotton tape. Secure the required amount of desiccant as prescribed in table II, section E of specification JAN–P–116 around the switchboard by means of cotton tape. Close and properly seal barriers.

Note.—Unless otherwise specified, shipping containers should be lined with a sealed waterproof bag, conforming to the requirements of JAN–P–125 for case liners. The container closure should be made as specified in the appendix of the applicable box specification. The shipping containers should be strapped as specified in the appendix of the box specification.

h. Marking.

(1) Interior packages should be marked in accordance with the requirements of Signal Corps Instruction No. 726–15.

(2) Contractors should mark shipping containers in accordance with the requirements of U. S. Army specification No. 100–2 and Signal Corps Supplement thereto.

(3) Signal Corps depots should mark shipping containers in accordance with Signal Corps Instruction No. 720–14, Depot Marking Manual.

i. Uncrating, Unpacking, and Checking.

(1) *General.* Equipment should be shipped in oversea or domestic packing cases. Sometimes the equipment is shipped in its own carrying case. When new equipment is received, select a location where the equipment may be unpacked without exposure to the elements of weather and which is convenient to the permanent or semipermanent installation of the equipment. No special unpacking and uncrating procedures are necessary for

equipment shipped in carrying cases other than making sure that all carrying cases are present and that the equipment is undamaged.

NOTE.—Be careful when uncrating, unpacking, and handling the equipment; it is easily damaged. If it becomes damaged or exposed to the elements, a complete overhaul might be required or the equipment might be rendered useless.

(2) *Export shipments.* Step-by-step instructions for uncrating and unpacking export shipments are as follows:

(*a*) Place the packing case as near the operating position as convenient.

(*b*) Cut and fold back the steel straps.

(*c*) Remove the nails with a nail puller. Remove the top and one side of the packing case. Do not attempt to pry off the sides and top; the equipment may be damaged.

(*d*) Remove the waterproof metal container or moistureproof barrier and any excelsior or corrugated paper covering the equipment inside the case. Be careful when removing waterproofing and protective wrappings not to remove any moistureproofing and fungiproofing coatings.

(*e*) Remove the equipment from its inner case and place it near its final location.

(*f*) Inspect the equipment for possible damage incurred during shipment.

(*g*) Check the contents of the packing case against the master packing slip.

(3) *Opening metal container.* The top of the metal container is soldered to the sides. To open, break the soldered seam by prying the side of the container away from the soldered seam as follows:

(*a*) Wipe off the excess solder with a soldering iron. Never use a torch because the contents of the container are inflammable.

(*b*) With a wooden block or a screw driver pry the sides from the soldered seam.

(*c*) When the seam is completely open, pry off the cover.

(*d*) Remove the bags of dessicant and the protective cardboard packing and lift or draw out the packages.

(*e*) Check the contents against the master packing slip.

(4) *Unpacking domestic packing cases.* The switchboard should be received in domestic packing cases. The instructions given in (2) above apply also to unpacking domestic shipments. Cut the metal bands. Open the cartons that protect the equipment, or, if heavy wrapping paper has been used, remove it carefully and take out the components. Check the contents of the packing case against the master packing slip.

NOTE.—Save the original packing cases and containers for both export and domestic shipments. They can be used again when the equipment is repacked for storage or for shipment to depot maintenance repair shop.

CHAPTER 2

OPERATING INSTRUCTIONS

Section I. SERVICE UPON RECEIPT OF EQUIPMENT

8. Service Upon Receipt of New Equipment

a. External Siting Requirements. The site for a station is governed largely by the tactical situation and local conditions, such as the need to conceal the station, the type of housing facilities (tents, buildings, etc.), the type of terrain, and the need to have easy access to the station. If possible, choose a location where a flat space is provided for setting up the equipment. Grade the ground if necessary. If a building is not available, provide a wooden platform, or support the equipment upon timbers or logs cut from trees. Be sure that drainage around the tent or shelter is adequate to prevent flooding the interior.

b. Interior Requirements. The shelter for the equipment must meet the following requirements:

(1) The floor must be capable of sustaining the weight of the equipment in a level position.

(2) There must be sufficient ceiling height to allow for air circulation around the switchboard.

(3) Sufficient space must be allowed behind the switchboard so that the rear panel may be opened for servicing and so that it is possible to walk behind the board. (Except for these limitations, the switchboard may be located anywhere convenient to the external power connections.)

(4) Adequate lighting for day and night operation must be provided. Position the switchboard so that the panel designation may be read easily by operating personnel. Artificial lighting should be accomplished with light bulbs placed so that the light falls directly upon the panel. A portable drop lamp and extension cord are convenient accessories for operating and maintenance personnel.

9. Preparation for Use

a. Electrical Connections. Telephone Switchboard SB–55(*)/FTC is completely wired internally when received. The only connections necessary are shown in figure 3 and listed as follows:

(1) A d-c supply of 48 volts for transmission of talking currents may be supplied from any reliable commercial or army source. If these sources are not obtainable, use storage batteries supplying 48 volts dc. Connect the d-c supply to terminals on the connecting rack as shown in figure 3. If batteries are used, a rectifier is necessary for maintaining a steady d-c supply of 48 volts to the switchboard.

(2) For ringing current, a reliable 110-volt, 60-cycle a-c (alternating-current) supply is necessary. Use a frequency converter in conjunction with the a-c supply, to change the 60-cycle current to 20 cycles. Connect the a-c supply to terminals marked GENERATOR on connecting rack as shown in figure 3.

(3) On SB–55A/FTC, connect a 110-volt, 60-cycle a-c supply by means of BX cable fed through a knock-out in the heater units receptacle.

b. Block Diagram. Figure 4 shows the relationship between the switchboard and associated equipment necessary for its operation.

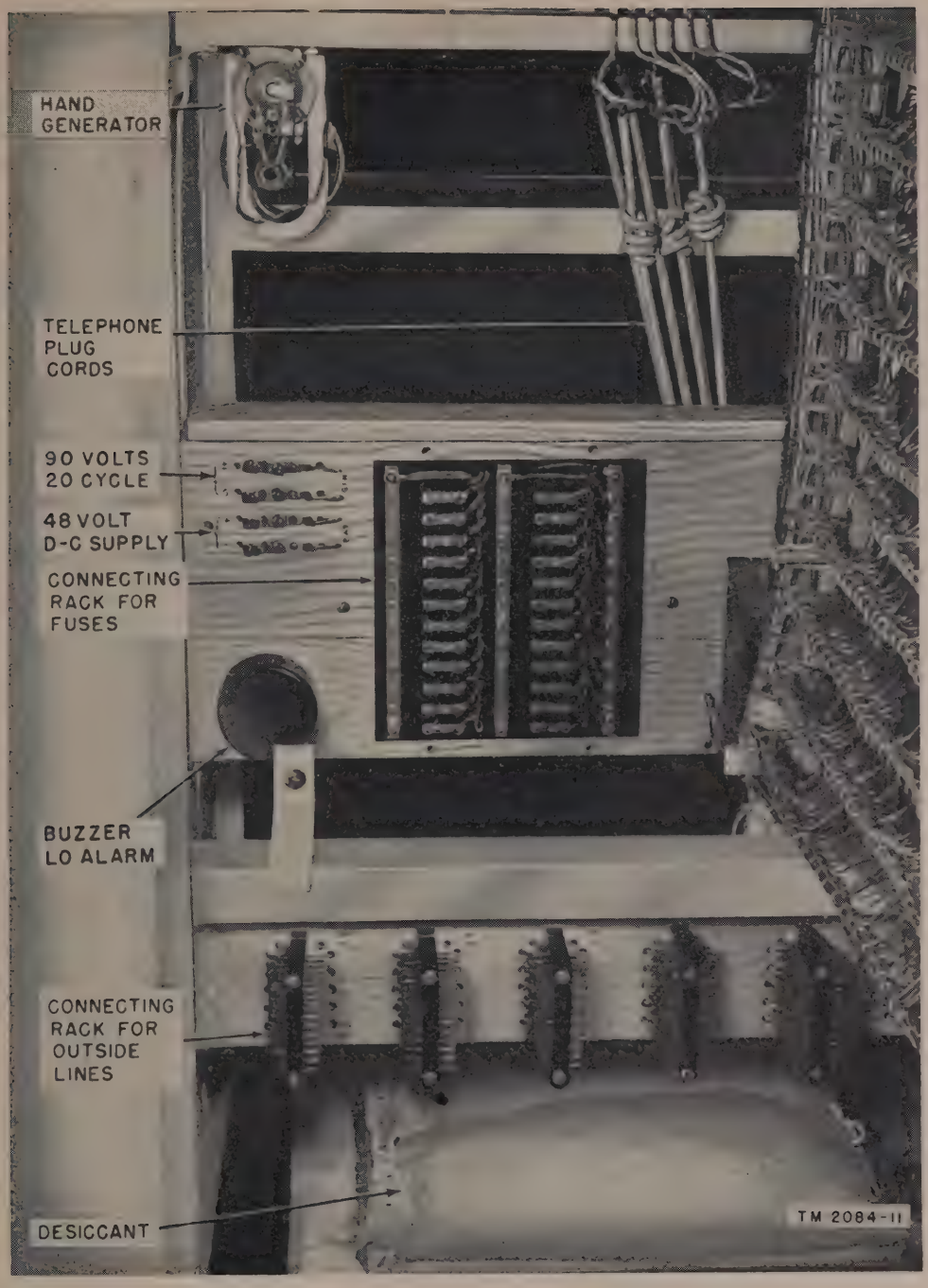


Figure 3. Telephone Switchboard SB–55/FTC, lower panel, interior view. (SB–55A/FTC has two heater units located on baseboard of switchboard.)

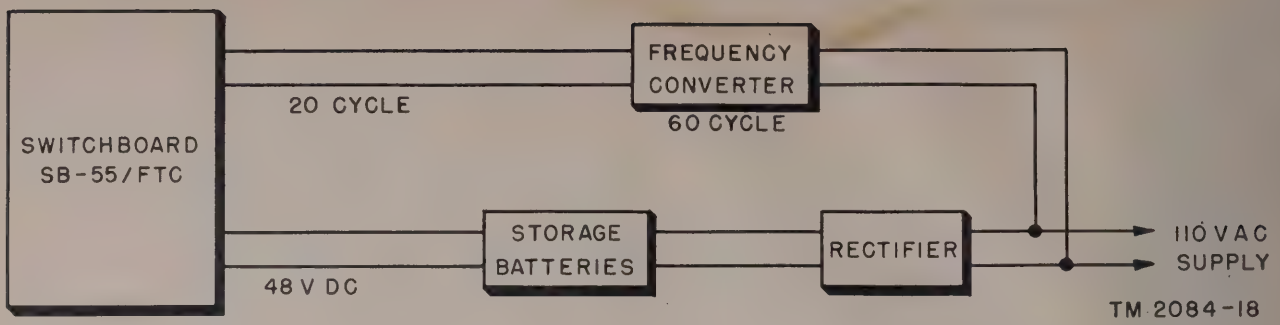


Figure 4. Block diagram showing relationship of Telephone Switchboard SB-55/FTC and associated equipment. (SB-55A/FTC requires an extra 110-volt, a-c connection direct to heater units.)

10. Service Upon Receipt of Used or Reconditioned Equipment

a. Follow the instructions in paragraph 7 for uncrating, unpacking, and checking the equipment.

b. Check the used or reconditioned equipment for tags or other indications pertaining to changes in the wiring of the equipment. If any changes in wiring have been made, note them in this manual, preferably on the schematic diagram.

Section II. OPERATION UNDER USUAL CONDITIONS

11. Controls

The table below lists the controls on Telephone Switchboard SB–55(*)/FTC. It also gives the location of the controls on the switchboard (fig. 5), and the function of each control.

Control	Location	Function
Switch, line	On key shelf	Makes and breaks the ringing and talking circuits of the 100 local lines.
Switch, trunk	On key shelf	Makes and breaks the ringing and talking circuits of the two trunk lines.
Cord, switchboard	On key shelf	Used to complete the circuits between calling and answering stations, by plugging them into the desired station jack.
Telephone, dial	On key shelf	Used for making PBX or trunk line calls.
Generator, hand	On right side of lock rail	Used to supply emergency ringing power in case of normal power supply failure.
Switch, ringing transfer	Upper front, right side of switchboard.	For switching from normal to emergency power.
Switch, buzzer, cut-off	On switchboard to right of ringing transfer switch.	For controlling buzzer in LO circuit.
Lamp, line-out, white	On key shelf	For giving visual signal of an emergency, reporting line out of order.
Lamp, line-call, red	On key shelf	For giving visual signal of an emergency, reporting line call finished.
Lamp, line-call, green	On key shelf	For giving visual signal of an incoming call from post telephone switchboard.
Lamp, power failure	On upper front, right side of switchboard.	For indicating operation of the fuses in the power plant or indicating a discharged condition of the power plant battery.
Lamp, ringing	To right of power failure lamp	Used to indicate failure of the ringing power.
Lamp, line, red	On jack panel	Used for giving visual signal on an emergency reporting line call.
Lamp, line-out, white	On jack panel	Used for visual signal of trouble on an emergency reporting line.
Buzzer	On lower left-hand corner of connecting rack.	Used for audible signal to indicate trouble on an emergency reporting line.
Switch, heater (SB–55A/-FTC only).	Switchboard, front, upper right panel.	For control of heating units.

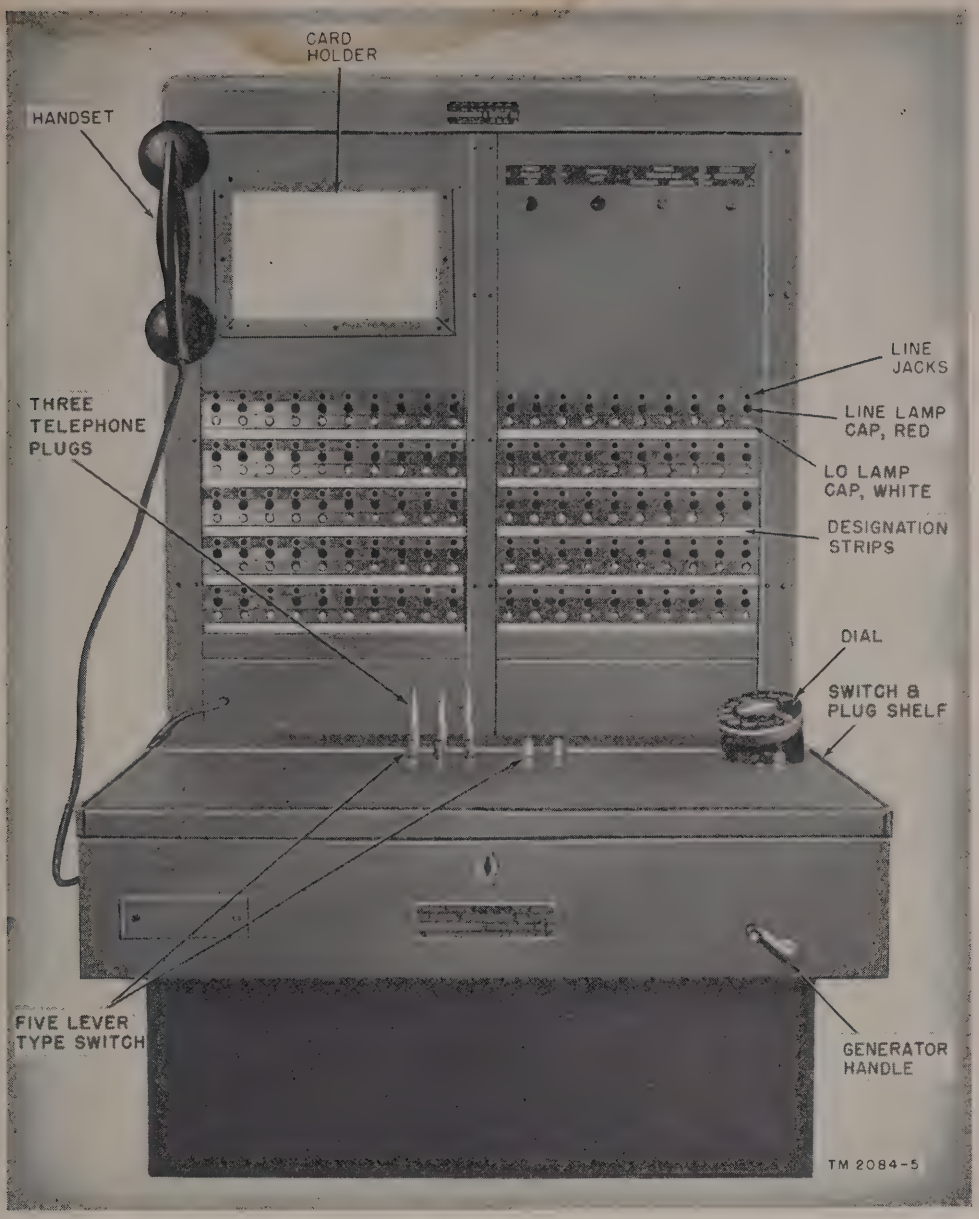


Figure 5. Telephone Switchboard SB–55/FTC, key and plug shelf and upper front panel. (SB–55A/FTC has heater switch on upper right panel of switchboard.)

12. Equipment Connections

a. Grounding Arrangements.

(1) One or more grounds are required at each field installation to minimize hazards to equipment and personnel from lightning and other sources of high voltage, to reduce crossfire interference, and to complete the d-c path for ground return telephone circuits. It is important that each item of equipment be connected to a low-resistance ground by conductors capable of carrying more than the maximum current which may come in contact with any part of the switchboard.

(2) Telephone Switchboard SB–55(*)/FTC has the frame grounded as shown in figure 6.

(3) Power supply should be grounded at the source. If batteries are used, be sure to ground them through nearest water pipe or another qualified substitute. For detailed information on grounding, see TM 11–676.

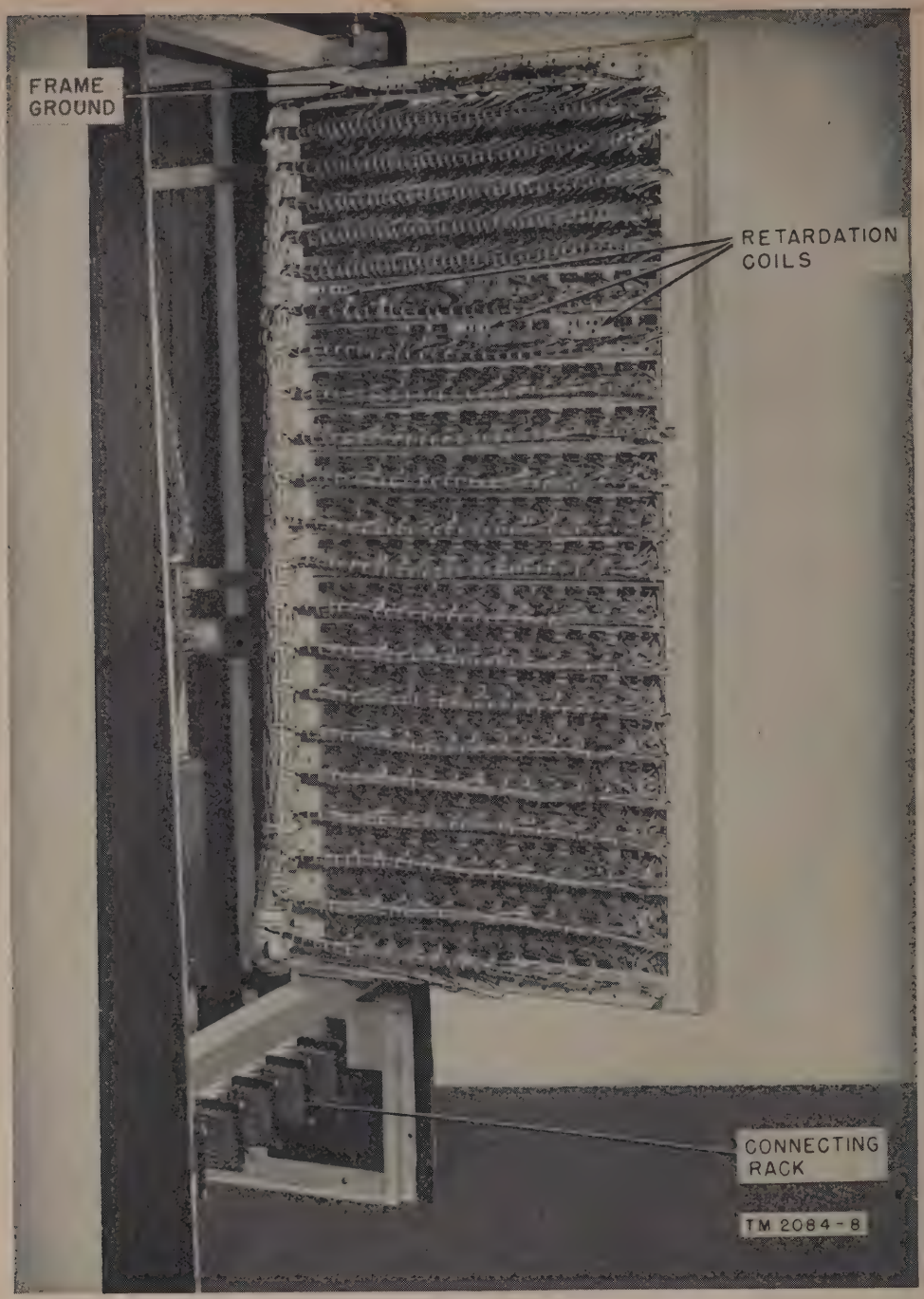


Figure 6. Telephone Switchboard SB–55(*)/FTC, inside view of relay gate showing frame ground and wiring.

b. Checking Voltage. Determine the voltage and frequency of power sources before making connections to them. When gas-engine power units are used, voltage and frequency data may be obtained from nameplates on the units. When the sources are commercial or military, the agency furnishing the power generally can supply the necessary information. Voltage and frequency data often can be learned from the nameplates of equipment already connected to the power source.

c. Connection to Lines. After the power and protective grounding connections are made, it is necessary to make connections between switchboard and emergency fire reporting lines. Figure 3 shows the connecting rack with numbered terminals for outside lines, 1 to 100.

d. Cords. Untie cord weights inside the board thus releasing the cords for operation.

e. Marking Designation Strips. The white paper strips, located within the designation strips associated with the emergency fire reporting lines, may be marked to indicate the location or termination of the line. These markings can be made by the removal of the transparent strip over the paper strip, after which, the marking may be made with pencil or ink and the transparent strip replaced.

13. Operation

a. To answer an emergency reporting line call, complete the following steps:

(1) Bell rings.
(2) Note which of the emergency reporting line signals (red-lamp) is lighted.
(3) Plug in with a cord and push back the switch which is in line with the cord used to TALK position.
(4) Answer with the hand telephone.
(5) When the red supervisory lamp in line with the cord lights, take down the cord and restore switch to normal CENTER position.

b. To call an emergency reporting line station, complete the following steps:

(1) Plug a cord into the line desired and ring by pulling forward the switch which is in line with the cord used to RING position.
(2) Red supervisory lamp in the cord will light when the line is plugged in and will be extinguished when the station answers.
(3) When the red lamp is extinguished, push back the switch which is in line with the cord used to TALK position and use the hand telephone.
(4) When the red lamp in line with the cord relights, take down the cord and restore switch to normal CENTER position.

c. Failure of the large white lamp, marked RINGING LAMP (located on the top right panel of the board), to light when the ringing switch is operated, indicates failure of the ringing power. If this occurs complete the following steps:

(1) Turn the red button, marked RINGING TRANSFER SWITCH, to the right. Then, while holding the ringing switch operated, turn the crank of the hand generator.
(2) Report the ringing failure to the telephone repair clerk.
(3) Restore the red button, marked RINGING TRANSFER SWITCH, to the left when trouble is cleared.

d. When an emergency reporting line goes ou of order, a white lamp lights and the buzzer sounds, indicating that the line associated with the lamp is out of order. If this occurs complete the following steps:

(1) Report this condition to the telephone repair clerk.
(2) Silence the buzzer by plugging a cord into the line. The white LO lamp in line with the cord will light.
(3) When the white LO lamp goes out indicating that the trouble is cleared, pull out the cord. (Silence the buzzer by turning the buzzer switch to the OFF position.)

e. Operation of the fuses in the power plant or a discharged condition of the power plant battery is indicated by the extinguishing of the amber lamp which is located directly to the left of the RINGING LAMP. To correct this condition, complete the following steps:

(1) Report the power failure to the telephone repair man. The amber lamp will glow automatically when the trouble is cleared.
(2) The buzzer also will sound when the amber lamp fails to glow and may be silenced by turning the buzzer switch to the OFF position.

f. A call from the post telephone switchboard will light a green lamp in line with one of the switches in the switch shelf. Push back the switch in line with the lamp to the half-way position marked TALK, and answer with the hand telephone.

14. Disassembly and Repacking

a. Remove the back of the switchboard.

b. Disconnect the incoming lines from the terminals on the connecting rack. Disconnect and remove the power supply lines to the battery and generator terminals on the connecting rack. Tie up cord weights inside board. Replace back of switchboard.

15. Purpose and Use of Equipment Performance Checklist

The equipment performance checklist will help the switchboard operator to determine whether Telephone Switchboard SB–55(*)/FTC is functioning correctly. The checklist gives the items to be checked, the normal indication of correct operation, and the corrective measures that the operator can take. Items 1 through 6 are checked before starting; items 7 and 8 when starting, and items 9 through 20 during operation.

16. Equipment Performance Checklist

	Item No.	Item	Action or condition	Normal indications	Corrective measures
Preparatory	1	Connecting rack	Incoming lines connected		
	2	Grounds	Frame should be grounded as shown in figure 6.		
	3	A-c power source	110 volts, 60 cycles		
	4	Batteries or d-c power.	48 volts dc		
	5	Rectifier	Connected for continuous charging		
	6	Frequency converter	Connected to a-c supply and switchboard.		
Start	7	Switch ringing transfer.	Turn to left for power generation. Turn to right for hand generator ringing.		
	8	Buzzer, cut-off switch.	Turn to ON position		
Equipment performance.	9	Switch, TALK-RING.	Plug into the line desired with one of the cords. Pull switch forward to RING position.	Red lamp in cord circuit will light.	Clean TALK switch contacts.
	10	Switch, TRUNK line.	Operate switch to TALK position. Have PBX operator call back.	Green light in line with switch will light.	Clean TRUNK switch contacts.
	11	Dial phone	Operate switch to TALK position, and dial.	Automatic exchange answers.	Clean and adjust TALK switch contacts.
	12	Lamp ringing	Ringing transfer switch in left position.	Large white lamp marked RINGING LAMP should light.	Check for faulty lamp.
	13	Lamp, power failure	Fuse removed or battery disconnected.	Amber lamp goes out and buzzer sounds.	Check for faulty lamp.
	14	Lamp, line, red	Emergency reporting line calls	Red lamp lights	Check for faulty lamp.
	15	Lamp, line-out, white.	Open on reporting line	White lamp on jack panel lights and buzzer sounds.	Check for faulty lamp and buzzer.
	16	Lamp, line-out, white (cord circuit).	Open on reporting line	White lamp on switch shelf should light.	Check for faulty lamp.
	17	Lamp, supervisory, red.	Insert plug into line jack. Pull associated switch forward to ring position.	Red lamp in line with cord should light.	Check for faulty lamp.
	18	Lamp, PBX, green	Operate switch to TALK position. Have PBX operator call back.	Green lamp in line with cord should light.	Check for faulty lamp.
	19	Ringing and supervisory circuits.	Insert calling cord into desired line jack and operate TALK-RING switch to ring. If using hand generator put switch in ring position, and crank the hand generator.	Bell of called station responds.	Check ringing source and connections from power ringing equipment.
	20		Distant station signals back	Line lamp, red, lights	Check for faulty lamp.

Section III. OPERATION UNDER UNUSUAL CONDITIONS

17. Emergency Operation

a. If the commercial power supply fails, connect the equipment to a site-generated power supply, using Power Unit PE–75, if possible.

b. If the power supply becomes erratic while using Power Unit PE–75, attempt to obtain a 110-volt, 60-cycle input from existing power lines.

18. Operation in Arctic, Tropical, and Desert Climates

a. General. Operation and maintenance of Telephone Switchboard SB–55*/FTC and associated equipment in arctic, tropical, or desert regions involve a number of problems which are peculiar to these regions. Deterioration of parts from rust or corrosion may lead to a complete break-down of the equipment. Entry into the equipment of dirt, dust, and sand, encountered in desert regions, affects operation and may lead to break-down. Batteries become inoperative in extremely cold regions. Guard against corrosion by keeping the equipment as dry as possible. In extremely cold regions use the equipment in a heated inclosure. Make sure the ground rods for the system are below the frost line. Refer to TB SIG 66 for data on extreme weather conditions. This switchboard should be capable of withstanding exposure to the following conditions, after which it should be capable of meeting the requirements noted in paragraph 5.

(1) Ambient temperature in the range of −40° to +55° C.

(2) Elevation up to 5,000 feet above sea level.

(3) Relative humidity up to 100 percent.

b. Operation in Arctic Climates. Efficiency of practically all types of equipment is affected directly by cold temperatures. Take great care to avoid rough handling of steel, glass, and rubber. Steel becomes more brittle, and glass is especially susceptible to sudden temperature changes. Canvas, such as that used for the covering over the portable passage way between the operations group trailers, will freeze and lose its pliability in extremely frigid climates. For best results in cold climates, keep the canvas straight and smooth whenever it is possible to do so. Insulating compounds on wires and cables become brittle under effects of cold, and must be handled accordingly. Cables connecting the MDF (main distributing frame) and telephone switchboard trailers are particularly susceptible to cold and should be handled with extreme care. To avoid shorts, keep receptacles free from ice and moisture. Refer to TB SIG 66.

c. Operation in Tropical Climates. Regular and careful inspection of all types of Signal Corps equipment operated in tropical climates helps to avoid various kinds of trouble. Especially watch for any signs of small insects eating cable sheath; this causes shorts and contacts in different kinds of cable. Transmission losses can be due to moisture and rust of poorly made joints in field wire. Loosening of poles because of damp earth and tropical storms is another cause of trouble. Cobwebs form on open wire circuits and lead to the increase of attenuation and crosstalk. TB SIG 72 covers tropical maintenance of ground signal equipment in detail.

d. Operation in Desert Areas. Sand is a powerful foe of any type of equipment used in desert areas. The scratching and gouging which it can cause may result in many types of trouble. Refer to TB SIG 75 for means which can be taken to protect equipment. Provide ventilation to allow sufficient cooling of equipment during the day. Minimize the chances of dust sifting into equipment. Storage batteries require more attention in such areas. Protect gasoline engines from sand and dust that will seep into carburetors and possibly from there into cylinders where grinding can be very damaging. Means of protecting the power units in such areas are outlined in TM 11–904.

CHAPTER 3
MAINTENANCE INSTRUCTIONS

Section I. SPECIAL ORGANIZATIONAL TOOLS AND PRESERVATION

19. Tools

a. Tools, parts, and sets supplied with Telephone Switchboard SB–55(*)/FTC (fig. 2) are listed as follows:

Adjuster, spring, No. 21 B&S gage slot.
Adjuster, spring, No. 23 B&S gage slot.
Burnisher, contact.
Extractor, lamp.
Pliers, duck-billed type.
Screw driver.
Scraper.
Tool, crimping.
Wrench, single open-end 1/8" opening.
Wrench, socket type, 1/4" opening.
Wrench, socket type, 7/16" opening.
Wrench, socket type, 3/8" opening.
Wrench, socket type, 5/16" opening.
Wrench, socket type, 7/64" opening.

b. Necessary organizational expendable supplies are authorized and replenished through appropriate T/A's. Tool Equipment TE–49 is issued to individual repairmen, and Tool Equipments TE–111 and TE–112 are normally supplied to field and depot maintenance repair organizations. These tool equipments contain all necessary tools for the repair and maintenance of telephone, telegraph, and teletypewriter equipments.

20. Weatherproofing

a. General. Signal Corps equipment, when operated under severe climatic conditions such as prevail in tropical, arctic, and desert regions, requires special treatment and maintenance. Fungus growth, insects, dust, corrosion, salt spray, excessive moisture, and extreme temperatures are harmful to most materials.

b. Tropical Maintenance. A special moistureproofing and fungiproofing treatment has been devised which, if properly applied, provides a reasonable degree of protection. This treatment is fully explained in TB SIG 13 and TB SIG 72.

c. Winter Maintenance. Special precautions necessary to prevent poor performance or total operational failure of equipment in extremely low temperatures are fully explained in TB SIG 66.

d. Desert Maintenance. Special precautions necessary to prevent equipment failure in areas subject to extremely high temperatures, low humidity, and excessive sand and dust are fully explained in TB SIG 75.

e. Lubrication. The effects of extreme cold and heat on materials and lubricants are explained in TB SIG 69. Observe all precautions outlined in TB SIG 69 and pay strict attention to all lubrication orders when operating equipment under conditions of extreme cold and heat.

21. Rustproofing and Painting

a. When the finish on the metal strips on the switchboard has been badly scarred or damaged, rust and corrosion can be prevented by touching up bared surfaces. Use sandpaper #00 or #000 to clean the surface down to the bare metal. Obtain a bright smooth finish.

Caution: Do not use steel wool. Minute particles frequently enter the case and cause harmful internal shorting or grounding of circuits.

b. When a touch-up job is necessary, apply paint with a small brush. When numerous scars and scratches warrant complete repainting, cover jack panel and key shelf and spray paint over the entire case. In severe cases it may be necessary to use solvent (SD) to soften the rust and sandpaper to complete the preparation for painting. Paint used will be authorized and consistent with existing regulations.

Section II. PREVENTIVE MAINTENANCE SERVICES

22. Definition and Importance of Preventive Maintenance

a. DEFINITION. PM (preventive maintenance) is work performed on equipment (usually when it is not in use) to keep it in such good working order that break-downs and needless interruptions in service will be kept to a minimum. It differs from trouble shooting and repair since its object is to eliminate both the need for repair and the correction of defects involving trouble shooting and repair.

b. IMPORTANCE. Since the failure or inefficient operation of even one item of an equipment may cause the break-down of an entire communication system, the importance of PM is at once apparent. Maintenance personnel must maintain equipment placed in their charge in such condition that it will work at top efficiency at all times.

NOTE.—Operations described in this section are organizational maintenance. See TM 38–650 for information on organizational, field, and depot maintenance.

23. Preventive Maintenance Tools and Materials

Before starting PM procedures, have on hand all tools and materials needed in performing the operations listed in the PM checklist (par. 25). These tools and materials may be obtained through regular supply channels.

a. TOOLS.

Signal Corps stock No.	*Item*
6Z1428	Brush: bristle; soft.
6Z1415.1	Brush: bristle; stiff.
6R41065C	Burnisher: TL–557/U.
6R4740–5	Pliers: flatnose.
6Z7360	Stick: orange.
6Z41274A	Wrench: double offset.

b. MATERIALS.

Signal Corps stock No.	*Item*
6G184.1	Carbon tetrachloride, lint-free.
8A805	Cheesecloth: bleached.
6G1385	Oil: neat's-foot (p/o Tool Set TE–56).
6G1516	Polish: metal paste.
6Z7500–0000	Paper: sand #0000; 9″ x 11″ sheets.
QM 51–S–1324	Soap: alkali-free.
QM 51–S–1775	Soap: saddle.
QM 51–S–4385–1	Solvent, dry-cleaning (SD).
6Z8666	Toothpicks: hardwood.

NOTE.—Gasoline will not be used as a cleaning fluid.

24. Purpose and Use of Preventive Maintenance Checklist

a. The checklist (par. 25) which follows shows the operator how to maintain the equipment so that trouble shooting and repair will be reduced to a minimum. It explains what to check, when to check, how to check, and precautions which should be taken before, during, and after checking the equipment. In most cases, the checklist is self-explanatory, and the operations and techniques do not require lengthy explanations.

b. The following is a key to symbols used in the checklist:

D—daily.
W—weekly.
M—monthly.
S—semiannually.
A—annually.

25. Preventive Maintenance Checklist for Telephone Switchboard SB–55(*)/FTC (Fire Reporting)

Item No. D	What to check	When to check	How to check	Precautions
1	Batteries	D	Inspect batteries for dust and dirt, broken sealing compound, leaking electrolyte. Wipe batteries with a dry cloth to remove moisture, dust, and dirt. Replace leaky batteries. Clean any electrolyte or corrosion from battery box with a cloth dampened with solvent (SD). Check the connections for tightness. Clean dirty or corroded connections with solvent (SD). Loosen corrosion with sandpaper #0000, if necessary, and wipe clean with a cloth moistened with the solvent. Apply a light coat of grease (GL) to the battery terminals.	Be careful when touching battery terminals. Do not have metallic object in hands.

25. Preventive Maintenance Checklist for Telephone Switchboard SB–55(*)/FTC (Fire Reporting)—Continued

Item No. D	What to check	When to check	How to check	Precautions
2	Binding posts and terminals.	M	Inspect the terminals and binding posts on the switchboard for dirt, dust, rust, and corrosion. Carefully examine the terminal strips for loose terminals. Tighten any loose terminals with a suitable screw driver. Do not force when tightening or the terminals will be damaged. Clean terminals and binding posts with a soft-bristle brush.	
3	Buzzer	D	Inspect mechanical action.	
4	Cables, cords, and plugs.	W	Cords, cables, and plugs are the life lines of the equipment. The condition of the cabling must be closely observed. Inspect cords and cables for cracked or deteriorated insulation. Check for frayed or cut insulation at connecting points and for improper connections which strain the wires or connections. Inspect for cracked or damage dplug shells. Remove the plug shells and tighten connections. Tighten loose cable clamps, coupling rings, cable connections, and strain reliefs. Tighten the case. Wipe grease, oil, and moisture from the cords, plugs, and sockets with a clean dry cloth. Clean any corrosion or stains from the plug with metal polish (Sig C stock No. 6G1516). Do not apply an excessive amount of polish. Remove all residue of polish after the cleaning operation to prevent interference with electrical contact.	Never use wet or damp cloths to clean cords. Never use a screw driver that is too large; this will damage slots.
5	Capacitors and resistors.	M	Resistors and capacitors usually require replacement by authorized repairmen. There are, however, several PM procedures which can be done by the operator. Inspect for loose or corroded connections, for cracked or damaged insulation, and for discoloration or bulging which indicates excessive heating at some time. Loose connections should be resoldered by an experienced repairman. Clean oil and grease from the units with a dry cloth. Wipe off excessive moisture with a clean dry cloth. Clean dirty or corroded connections.	
6	Dial	W	Inspect the dial for a loose or bent finger wheel or finger stop, and for dust, dirt, or pencil marks on the number plate. Clean the plate with a dry cloth. Moisten the cloth with solvent (SD) if necessary to remove clinging dirt or pencil marks. Test the dial by dialing the dial test number of the associated dial office.	
7	Fuses	W	Check for burned-out fuses. Inspect fuse caps for burning, charring, and corrosion. Inspect fuse ends for dirt and corrosion. Check fuse holders for cleanliness and foreign matter. Brush all dirt, dust, and foreign matter out of fuse holders. Clean all fuse ends with a clean dry cloth. Check for correct size.	Remove fuses with fuse pullers, if possible.
8	Hand generator	W	Inspect the generator for dirt, dust, rust, corrosion, and foreign matter. Look for damaged, loose, or missing mounting screws. Tighten all terminal screws and mounting screws. Using a soft-bristle brush, carefully remove all dirt, dust, and foreign matter on the generator.	Be careful not to disconnect any wires when performing this operation.

25. Preventive Maintenance Checklist for Telephone Switchboard SB–55(*)/FTC (Fire Reporting)—Continued

Item No. D	What to check	When to check	How to check	Precautions
9	Jacks and switches	M	Inspect the mechanical action of each switch and jack. Observe the action of the switches by operating them a few times. Note the contact separation and see that contacts close with a slight follow when the switch is operated. Inspect the mechanical action of each jack by inserting a plug into the jack. Look for dirt and corrosion on all exposed elements and examine the contacts for dirt, pits, and build-ups. Tighten loose assembly screws with a suitable screw driver. Clean switches and jacks and adjust spring tension and contact gap.	Do not force screws when tightening.
10	Switchboard exterior	D	Inspect for damaged places, chipped paint, dirt, dust, rust, corrosion, loose or missing screws. Tighten all loose screws. To remove oil, grease, or foreign matter, clean with a dry clean cloth, slightly moistened with solvent (SD). Wipe with dry cloth.	Tighten screws; never force.
11	Relays	W	Inspect relays for dirt and dust on only the outside cover. Use a small soft brush or clean dry cloth to clean the outside cover.	Do not attempt to clean inside relay covers. Do not dust inside of relay covers or the relay itself.
12	Terminal blocks	M	Terminal blocks are used for receiving and connecting, and as distributing points for electrical currents. They consist of a strip of insulation with screw or solder connections. They require little PM, especially if the equipment has not been removed. Inspect terminal blocks for loose connections, cracks, breakage, and dirt. Carefully examine the connections for mechanical defects, dirt, and corrosion. Tighten loose screws, bolts, and mounting lugs. Use a screw driver of the right size. Do not use excessive force. Remove and clean dirty or corroded connections before tightening. Clean terminal blocks, when necessary, with a dry brush. Wipe off all moisture with a clean dry cloth. When a dry cloth will not remove dirt and corrosion, use a cloth moistened with solvent (SD), wipe off the block with a dry cloth, and brush to remove all lint.	
13	Wiring	M	Inspect for cracked, frayed, or torn insulation. Check for loose connections, dirty contacts, and faulty lacing. Look for any wiring which may not have sufficient clearance from moving parts. Tighten any screw connections which may be loose. Resolder loose or broken soldered connections. Place all wiring in the proper place and retie if necessary. Soldering should be done by an experienced mechanic. Clean off all moisture, oil, and grease from the wiring with a clean dry cloth. Clean all connections before reconnecting.	Be careful not to disconnect any wires when performing these operations.

25. Preventive Maintenance Checklist for Telephone Switchboard SB–55(*)/FTC (Fire Reporting)—Continued

Item No. D	What to check	When to check	How to check	Precautions
14	Switch shelf	W	Pull the test cords up as far as possible, observing that the cord weights move freely. Inspect the cords for dirt and frayed jacketing and loose connections at the plugs. Clean the cords with a dry cloth or brush. Replace cords with excessively frayed jacketing. Examine the plugs for cracked shells and excessively chipped or cracked insulators or loose shells. Tighten loose connections or shells and replace plugs which have excessively chipped insulation or cracked shells. Clean plug contacting surfaces with rouge metal polish; be careful to remove all traces of the polish.	

NOTE.—The following figures show locations of items mentioned in PM checklist.

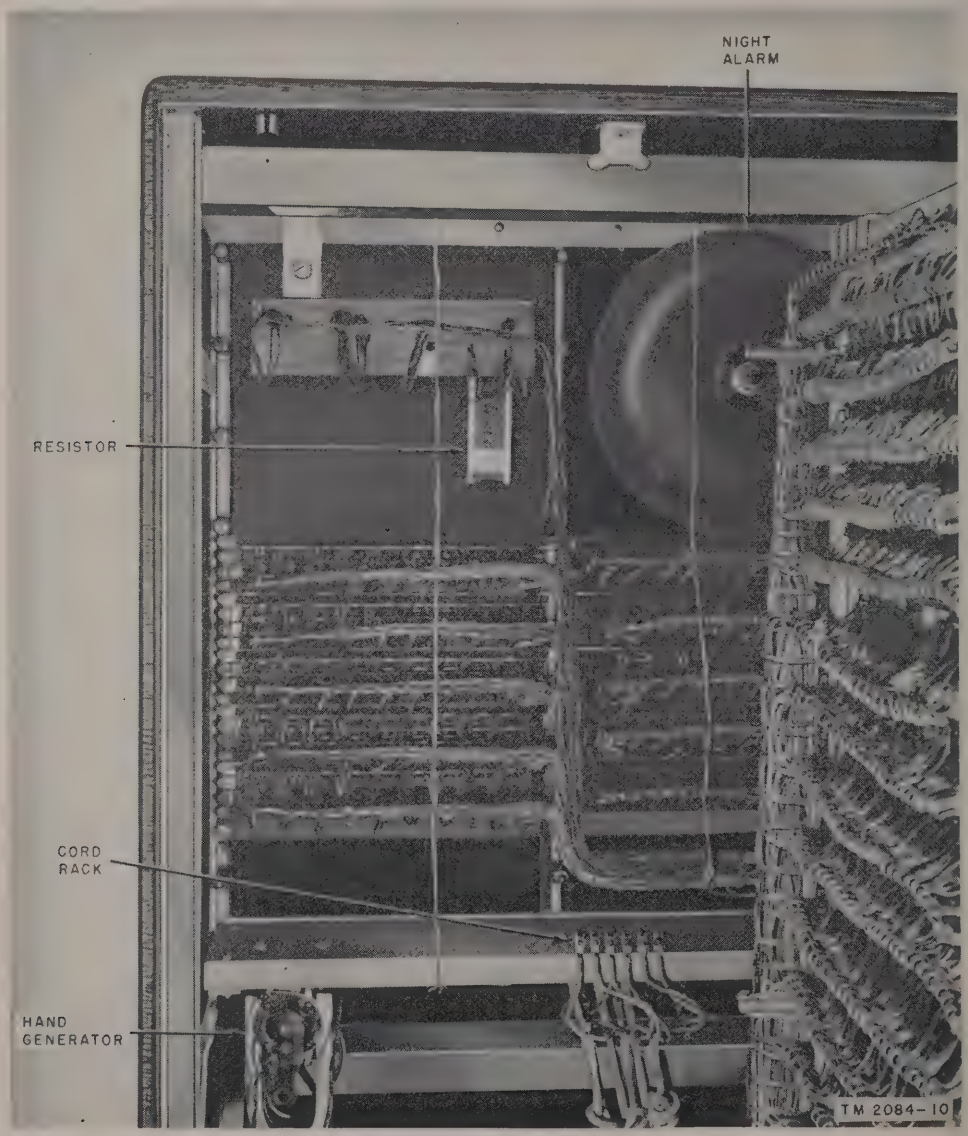


Figure 7. Switchboard SB–55(*)/FTC, upper rear portion, interior view.

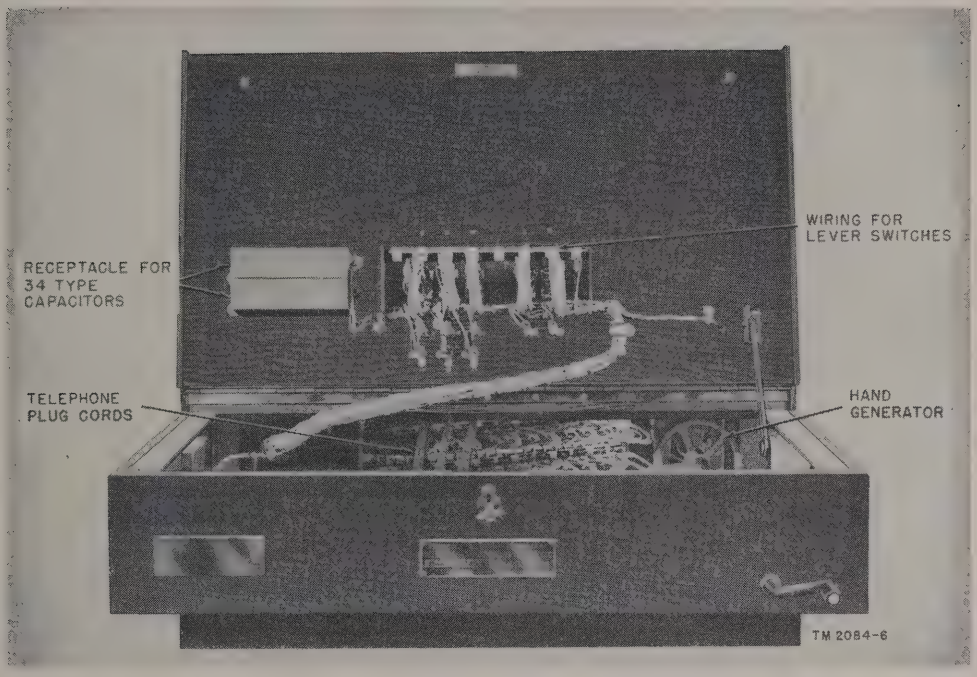


Figure 8. Switchboard SB–55(*)/FTC, key shelf, interior view.

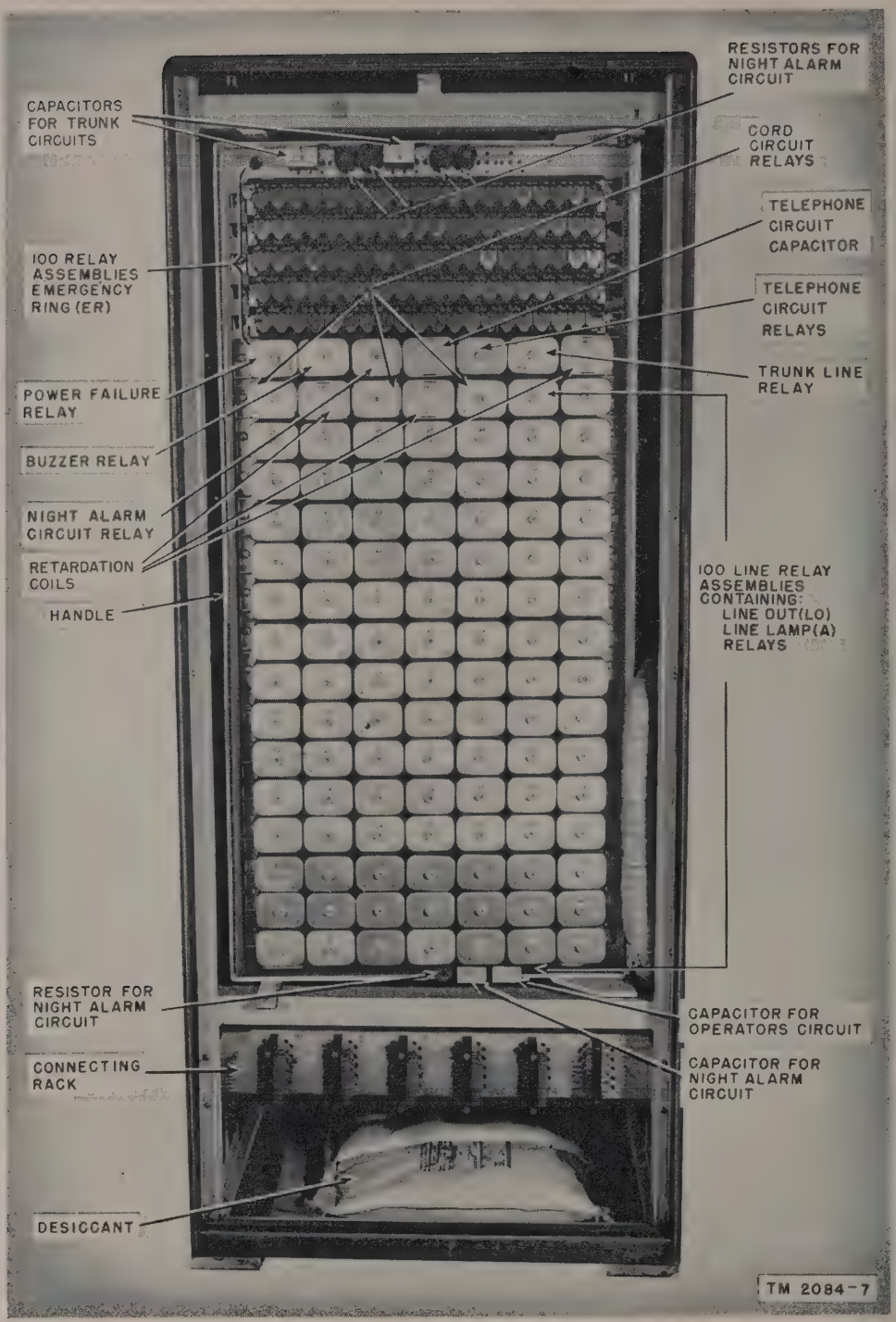


Figure 9. Switchboard SB–55(*)/FTC, relay gate.

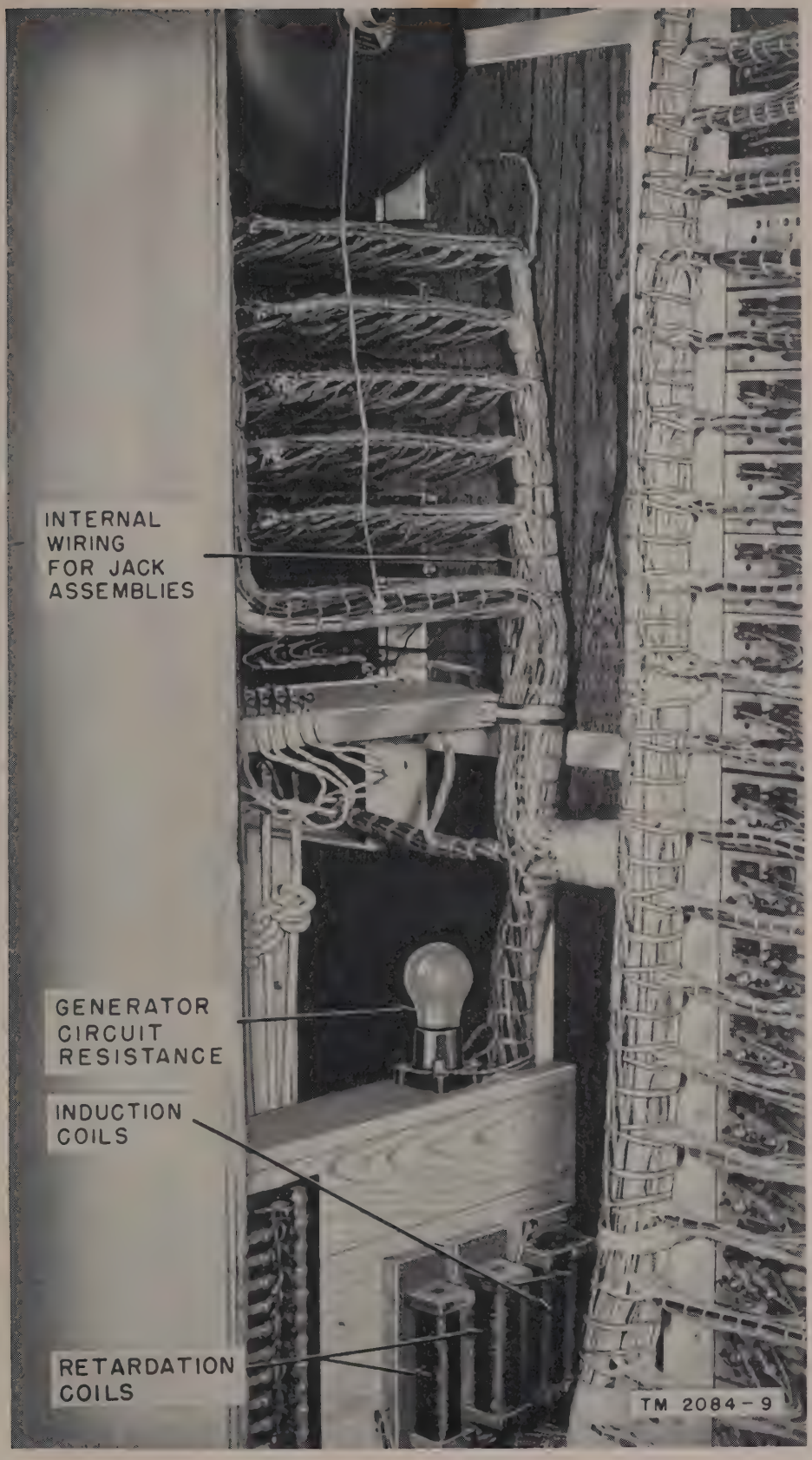


Figure 10. Switchboard SB–55(*)/FTC, lower rear portion, interior view.

CHAPTER 4

FIELD AND DEPOT MAINTENANCE INSTRUCTIONS

Section I. GENERAL

26. Scope

This chapter contains information for field and depot maintenance personnel applicable to all phases of repair through and including rebuilding of the equipment. It outlines the repair procedures to recondition the equipment, the procedures for testing the equipment, requirements which should be met after repair, and methods for locating and clearing troubles which are disclosed as a result of the test procedures. The amount of repair to be performed by any particular unit having field or depot maintenance responsibilities is, in these instructions, limited only to the tools, test equipment available, and skill of the assigned personnel.

27. References

a. See the technical manuals listed below before testing, adjusting, or repairing Telephone Switchboard SB–55(*)/FTC.

(1) *TM 11–4301.* This technical manual covers the general requirements of repaired equipment, detailed physical repairs, and the sequence of repair procedures; it also lists tools, test sets, and power requirements.

(2) *TM 11–4302.* This technical manual outlines the mechanical and electrical requirements and adjustments of all adjustable apparatus such as relays, keys, jacks, drop signals, etc.

b. Refer to chapters 2 and 3 for instructions on the operation and maintenance of Telephone Switchboard SB–55(*)/FTC.

Section II. THEORY OF OPERATION

28. General Functioning of Equipment

a. The operation of the circuits used in Telephone Switchboard SB–55(*)/FTC is described in the following paragraphs. Basically, the switchboard is a common battery telephone switchboard consisting of the following circuits; line, cord, battery, operator's telephone, and two trunk circuits. Additional circuits consist of night alarm, line-out alarm, alarm and ringing, and power failure.

b. A common battery switchboard furnishes the battery current for the conversation and the ac for ringing power. The answering and calling cords of a common battery switchboard are three-wire conductors. Two wires are used for the transmission and are called the *tip* (positive) and the *ring* (negative). The third wire in each cord is termed the *sleeve*, and is not used for transmission of voice currents, but only for supervision and control.

c. Figure 32 is an over-all schematic diagram of the switchboard showing the fire reporting circuit in its entirety, illustrating the relationship between the various subsidiary circuits.

d. Figures 11 through 16 are schematic drawings of Telephone Switchboard SB–55(*)/FTC showing each circuit in detail.

29. Line Circuit (fig. 11)

a. The line circuit includes two subsidiary circuits, the annunciator circuit and the night alarm circuit.

b. Normally, relay ER is inoperative because of the high variable resistance (3,500 ohms) in the telephone. When the telephone receiver is removed, relay ER closes its contacts 1 and 2. This is due to the fact that the lower resistance in the telephone-receiver circuit is placed in parallel with the high variable resistance in the telephone, thus increasing the flow of current through relay ER.

c. Tracing the circuit under above conditions, current flows from the battery through relay ER and divides at point 3. From point 3 it flows through relay ER contact 1, through relay LO contact 1 to ground. This is called the holding

circuit which maintains relay ER in an operative position. The current also flows from point 3 through the ring side of the jack, through the line, through the telephone, back through the line, and through the tip side of the jack through relay LO to ground.

d. When relay ER is operative, contact 2 is also closed, thus completing a circuit from battery through contact 2 of relay ER. At contact 2 of relay ER, the current divides and one branch flows through the line lamp through relay 10 to ground. The other branch flows through winding 3–4 of relay A, through relay 10 to ground. This circuit closes contacts 4 and 5 of relay A and causes current to flow from battery through winding 1–2 of relay A, through contact 4 of relay A, through release switch of the annunciator circuit, to ground. This is a holding circuit maintaining relay A in operative position. Relay A also closes circuit to annunciator lamp to ground, through contact 5 of relay A. Operation of the release switch in the annunciator cabinet releases annunciator by removing the ground, extinguishing annunciator lamp.

e. When relay 10 is energized, contact 1 is closed and causes current to flow from battery through the night alarm bell to ground. A 200-ohm resistor and a 2-mf capacitor are used to keep the noise currents generated in the bell out of the talking circuits.

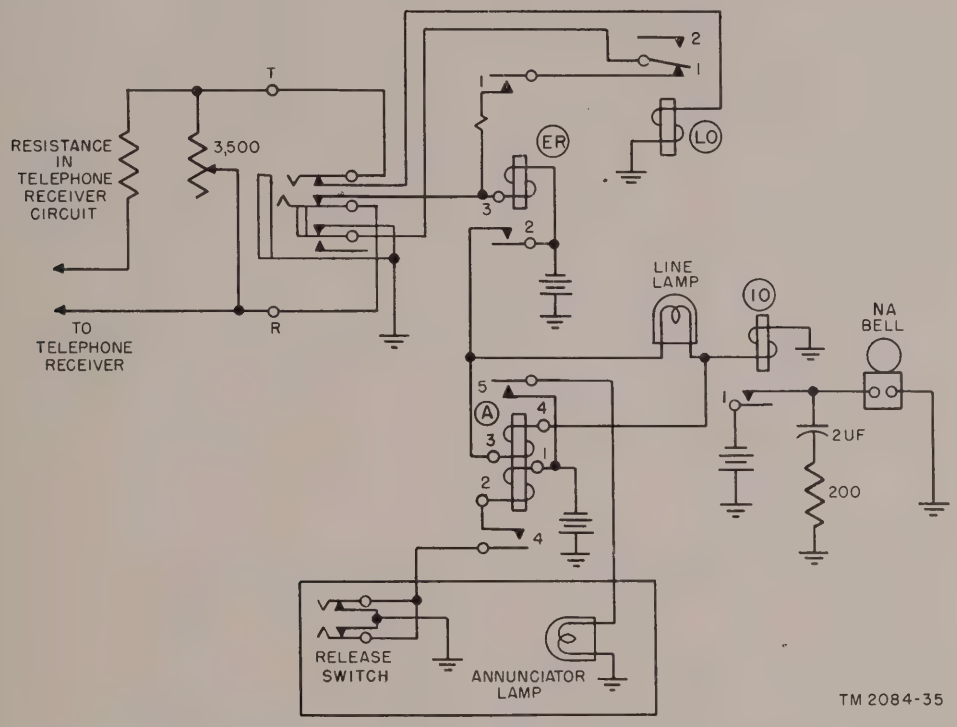


Figure 11. Telephone Switchboard SB–55(*)/FTC, line circuit, schematic diagram.

30. Cord Circuit (fig. 12)

a. The cord circuit consists of two parts, the ringing and talking circuits which are controlled through the TALK-RING switch of the cord circuit.

b. With the TALK-RING switch in normal position and the cord not plugged into the jack, the cord circuit is not energized. When the plug of one of the cords is inserted in one of the jacks on the switchboard, current flows from the battery through coil 1–2 of relay R, which is a retardation coil (to prevent flow of ac), through relay S, through TALK-RING switch, through the tip side of the plug, through the tip side of the jack, through the line, through the variable resistance of the telephone, back through the line, the ring side of the jack, the ring side of the plug, through relay P, through coil 3–4 of relay R back to ground.

c. Relay P is operative at 0.010 ma (milliamperes), therefore when the cord is plugged in, current flowing in the circuit operates relay P thus opening contact of relay P and preventing the LO (line-out) lamp from lighting.

d. Relay S operative at 0.035 ma remains closed thus allowing current to flow through the red supervisory lamp in line with the cord. The current flows from battery through the red lamp, through contact of relay S, through the sleeve of plug and jack to ground.

e. When the telephone receiver is removed, the increase of current flow (as explained in line-out circuit) will operate relay S thereby extinguishing the red supervisory lamp in the cord circuit.

f. When the TALK-RING switch is placed in RING position thus closing contacts 1 and 2 of RING side of switch, and the cord is plugged in, current flows from the a-c power source through the RING side of the TALK-RING switch, out on the line to the telephone bell, back through the tip side of the line, through the jack, plug, and tip side of the TALK-RING switch back to the other side of the a-c power supply.

g. In case of a power failure, the generator switch may be used to connect the hand generator to ringing power circuit.

h. When the TALK-RING switch is placed in TALK position, contacts 3 and 4 of TALK side of the switch are closed, current flows from battery through relay R, relay S, to TALK position of TALK-RING switch where it divides at points X and X[1], as explained in *i* and *j* below.

i. Current flows from battery through relay R, relay S, the tip side of switch, through the plug, jack, and telephone, and back through the jack, plug, and TALK-RING switch on the ring side through relays P and R, back to battery.

j. Current also flows from point of division X, through the operator's circuit, and trunk circuits 1 and 2 (fig. 32).

k. When trouble is indicated by the LO line lamp and operation of the buzzer, plugging in a cord will silence the buzzer and extinguish the LO line lamp (par. 32). The white LO lamp in line with the cord will light because that circuit is closed from battery through the relay P contact, through sleeve to ground. When trouble on the line is cleared, the LO lamp in line with the cord will be extinguished indicating that the trouble is cleared. The LO lamp goes out because of operation of relay P as explained in *c* above.

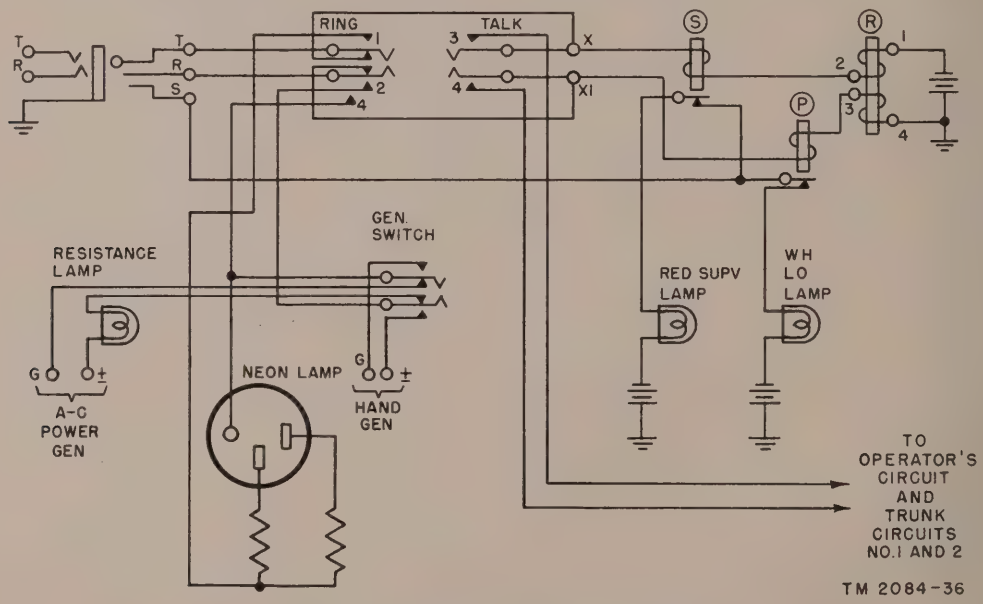


Figure 12. Cord circuit, schematic diagram.

31. Alarm and Ringing Circuit

a. The alarm and ringing circuit is a visual indicator showing that ringing power is being supplied.

b. At RING position of the TALK-RING switch in the cord circuit (fig. 12), at points 3 and 4, a No. 359A vacuum tube (neon lamp) is connected across the ringing circuit. When the ringing circuit is energized, the vacuum tube lights; this indicates that ringing power is being supplied.

32. Line-Out Circuit (fig. 13)

a. The line-out circuit is used for the purpose of indicating an open on one of the emergency re-

porting lines. Figure 13 is a schematic diagram showing the line-out circuit in detail.

b. Current flows through the circuit from the battery through relay ER. Relay ER is normally open because winding AB of relay ER is of such a value that 0.030 ma would be required to close the contact. Normally, the current flowing through the circuit, which is limited by the high resistance (3,500 ohms) in the telephone, is sufficient only to energize relay LO operative at 0.010 ma, thus maintaining contact 2 in an open position. From relay ER, the current flows through the ring side of the jack, through the line, through a variable (3,500 ohms) resistance in the telephone, back through the tip side of the jack, and through the LO relay to ground.

c. If an open develops in the line, relay LO is de-energized because of the failure of the current supply. Contact 2 is closed mechanically, thus completing a circuit from ground on the jack, through contact 2 of the LO relay, through lamp LO, through relay 13, to battery.

d. Relay 13 is energized and the contact is closed; this causes current to flow from the power generator, through the buzzer LO alarm, through the LO alarm switch, back to ground. By operating the LO alarm switch, the buzzer can be quieted. The buzzer also may be silenced by plugging a cord into a jack. Relay LO is energized by battery from relay R in the cord circuit (fig. 12). Current flows through relay R, relay S through the TALK-RING switch, through the plug and jack, through relay LO to ground. Current flows from ground to battery on relay ER to ring side of jack, through the plug, the TALK-RING switch, through relay P, through relay R to ground. Relay LO contact 1 is closed, thus silencing the buzzer and extinguishing the white LO lamp on the line.

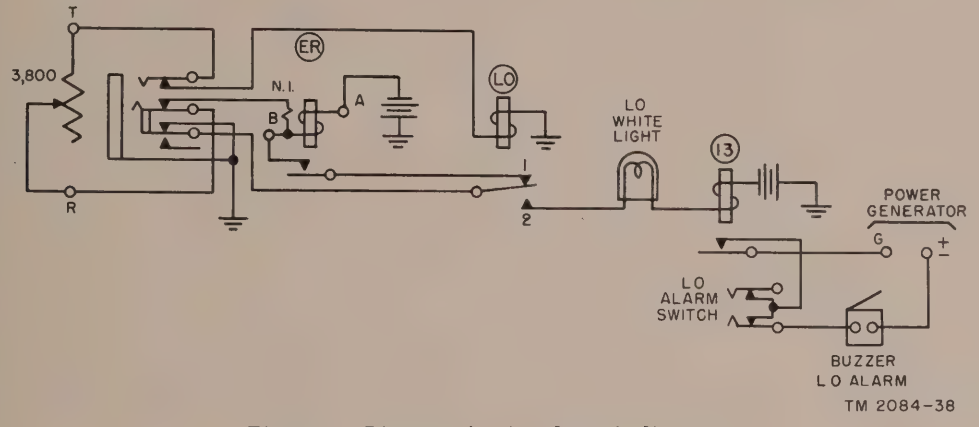


Figure 13. Line-out circuit, schematic diagram.

33. Operator's Circuit (fig. 14)

a. The operator's circuit consists of two parts, the primary or transmitter circuit, and the secondary or receiver circuit. The hand telephone set used in the operator's circuit combines both the transmitter and receiver circuits. Because of the close mechanical coupling between the receiver and transmitter, an antisidetone circuit is used to prevent excessive noise. In an antisidetone circuit an equal and opposite voltage is impressed simultaneously on the receiver by a balancing winding (see TM 11–685).

b. The transmitter circuit consists of the primary of the induction coil, a transmitter, a choke coil, a capacitor, and the 48-volt battery.

(1) The battery is connected in series with the high resistance choke coil which is used to reduce the transmitter current to the proper value and prevent voice currents from passing through the battery.

(2) The capacitor provides a bypass for voice currents around the battery and choke coil.

c. The receiver circuit consists of the secondary of the induction coil, a receiver, and a capacitor, and is connected directly across the cord circuits by listening switches. The capacitor opens the circuit to dc, insuring proper supervision. A suppressor is bridged across the receiver terminals to reduce acoustic shock to the operator from excessive voltages across the receiver terminals.

d. The operator's circuit may be traced from the RING-TALK switch in the cord circuit as

follows: Plug into a line and ring by pulling the switch forward. When the station answers, push the switch back to the TALK position and use hand telephone. From the tip side of the TALK switch, a-c current flows through capacitor A, through the secondary side of the induction coil and retardation coil Y, through contact 3 of relay 2 to the RING side of the TALK switch. Current also flows from point R of the secondary side of the induction coil, through the receiver, through capacitor 4, through contact 2 of relay 1, back to RING side of TALK switch. Current also flows through the suppressor coil across the receiver.

e. In the primary circuit, d-c current flows from the battery through the high impedance choke coil, through the capacitor, through the primary circuit of the induction coil, through the transmitter of the telephone, back to ground on the TALK switch.

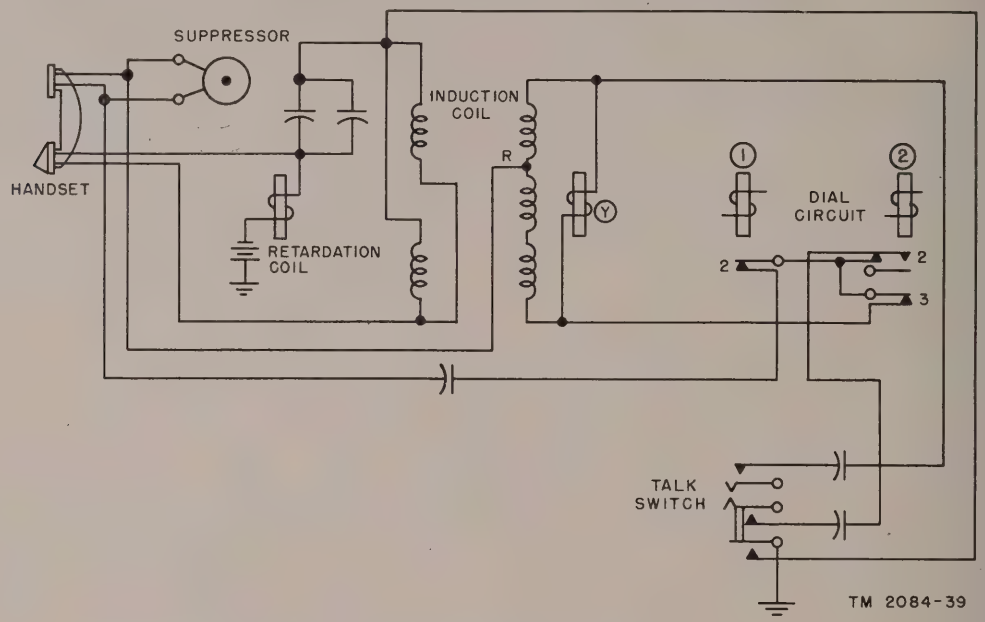


Figure 14. Operator's circuit, schematic diagram.

34. Trunk Circuit (fig. 15)

a. The line or voice channels connecting a switchboard in a telephone central office (TCO) to a switchboard in another TCO, or to another switchboard in the same TCO, are called trunk lines or trunk circuits.

b. In the Telephone Switchboard SB–55*/FTC there are two trunk circuits connected in parallel with the operator's circuit (refer to schematic diagram).

c. When an outside switchboard makes an incoming call, a-c ringing current flows from the tip side of the line through the relay, through the thermistor which gradually decreases the flow of current as the coil heats up, through the capacitor, back through the RING side of the line to the originating source of the call.

d. When relay 5 is energized, contacts 1 and 2 close, thus causing d-c to flow from the battery through relay 5, through contact 1, through resistance to ground on the TALK switch in a normal position. D-c flowing through relay 5 locks contacts 1 and 2, causing current to flow from the battery through contact 2 of relay 5, through the green lamp, through relay 10 to ground. When current flows through relay 10, contact 3 closes, allowing current to flow through the night alarm to ground. When the TALK switch is operated to TALK position, ground is removed from relay 5. Contacts 1 and 2 open, and both the green lamp and night alarm cease to operate. The HOLD position of the switch is used for maintaining the call of one trunk while the operator answers or makes a call on the other trunk line.

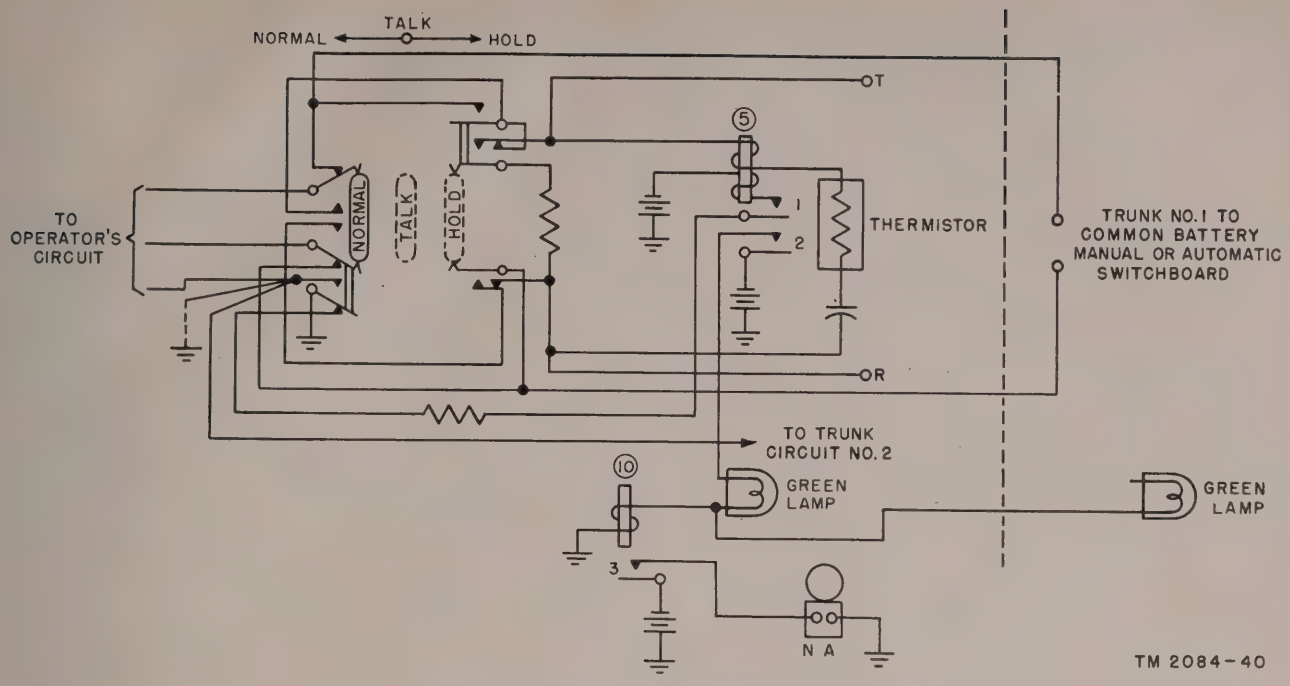


Figure 15. Trunk circuit, schematic diagram.

35. Power Failure Circuit (fig. 16)

a. The power failure circuit is designed to indicate either a failure in the d-c power supply or a discharged condition of the batteries.

b. Power is supplied to relay 16 and the amber pilot lamp. Relay 16 is maintained in an operative position preventing a flow of current to LO buzzer alarm from a-c source. If a d-c power failure or a discharged condition of batteries occur, contact 1 of relay 16 releases, causing current to flow from an a-c power supply through contact 1 of relay 16, through LO alarm switch, through LO buzzer alarm back to a-c power supply.

c. The amber pilot lamp burns continuously until power failure.

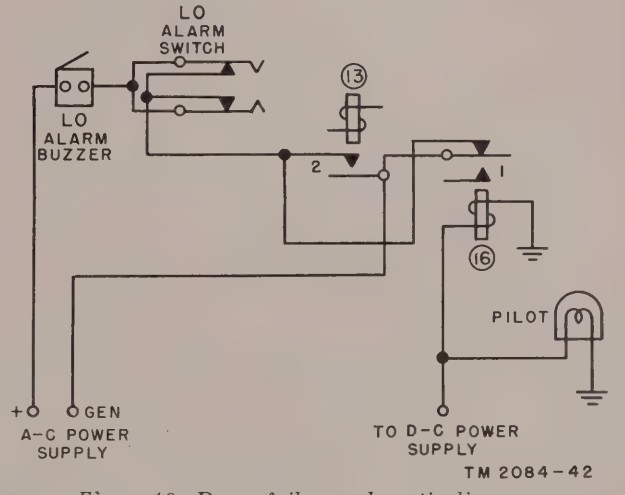


Figure 16. Power failure, schematic diagram.

Section III. PREREPAIR PROCEDURES AND POWER REQUIREMENTS

36. Test and Repair Equipment

The tools, materials, apparatus, and test equipments required for reconditioning, adjusting, and repairing Telephone Switchboard SB–55*/FTC are listed below.

a. Tools.

Signal Corps stock No.	*Name of tool and description*	*Used to—*
6R40067	Adjuster, spring: steel w/black finish 5¼″ lg x 3/16″ diam; single end, 90° bend; #21 B&S gage slot.	Adjust switch springs.
6R40060	Adjuster, spring: steel w/black finish 6″ lg x 5/16″ wd x ⅛″ thk; double ended, 15° bend; #23 B&S gage slot.	Adjust center springs of relay pile-ups.
6R40068	Burnisher, contact: steel, polished finish; 6″ lg x 3/16″ wd x 1/32″ thk	Clean contacts.
6R40025	Extractor, lamp	Extract switchboard lamps.
6R40858	Pliers: duck-billed type	Adjust telephone heat coils.
6R40004	Scraper: steel, cad pl; 5¾″ lg x 3/16″ diam	Clean springs and contacts.
6R40022	Screw driver: 1 13/32″ blade; 5¾″ lg over-all; 5/32″ diam shank; 0.040″ wd x 0.023″ thk bit; hardwood stained handle.	Adjust hollow switchboard plug screws.
6R40039	Tool: crimping lever action; 5″ lg; steel; smooth jaws w/two grooves.	Assemble terms on tinsel cords.
6R4008	Wrench: single open end; ⅛″ openings; 2½″ lg x 7/16″ wd x 3/32″ thk; head offset 45°; flat straight handle.	Adjust drop armature.
6R40011	Wrench: socket built into wrench; ¼″ opening; 4¾″ lg x ⅜″ OD socket body; steel w/black finish; straight.	Adjust relay armature nuts.
6R40013	Wrench: socket built into wrench; ⅜″ opening; 8″ lg x 9/16″ OD socket body; steel w/black finish; straight; screw driver handle.	Adjust relay mounting nuts.
6R40014	Wrench: socket built into wrench; 5/16″ opening; 18¼″ lg x 7/16″ OD socket body; steel w/black finish; straight screw driver handle.	Adjust jack pin nuts.
6R40016	Wrench: socket built into wrench; 7/64″ opening; 8″ lg x 3/16″ OD socket body; steel w/black finish; straight screw driver handle.	Adjust stop nuts on No. 1000 cam type switches.
6R40012	Wrench: socket built into wrench; 7/16″ opening; 5¼″ lg x 9/16″ OD socket body; steel w/black finish; straight screw driver handle.	Relay cover nuts.

b. Materials.

Signal Corps stock No.	*Name of tool and description*	*Used to—*
NSNA	Cloth: acetate; (WECo 8950)	Clean various parts.
6Z9666	Toothpicks: hardwood; flat one end, pointed other end	Lubricate points hard to reach. Opens spring contacts.

37. Power Supply

The power supply required to test Telephone Switchboard SB–55*/FTC with its recommended source is listed as follows:

a. Any stable commercial or military source capable of delivering 48 volts d-c.

b. Any stable commercial or military source capable of delivering 110 volts a-c, 60 cycles.

Section IV. INSPECTING, STRIPPING, CLEANING, AND LUBRICATING

38. Inspecting

a. Repair Factors. Make a visual inspection of equipment when it is returned for repair. Analyze the extent of repair necessary and see whether the condition of the equipment warrants repair. Give consideration to the two following factors: first, whether the replacement and repair of major components and parts justifies the expense involved, and second, the urgency of returning the equipment to service. If there is urgent need for the equipment and a replacement is not available the expense is justified. If there is not urgent need and the repair involved would amount to a rebuilding operation with the replacement of many expensive parts and components, salvage the equipment. If the equipment is salvaged, strip it of all usable parts and place them in stock for re-use.

b. Fabricating Parts. New parts often can be fabricated locally, using the damaged part as a model. For example, a switch shelf or a piling rail may be made locally, and may be replaced by a new part at some future time. Some

examples of apparatus repairs which can be made locally follow:

(1) A retardation coil is tested open.
  (*a*) Remove coil from mounting.
  (*b*) Remove outer insulating covering.
  (*c*) Remove defective winding. Count the number of turns.
  (*d*) Gage size of wire used.
  (*e*) Note insulating material between windings and between winding and core.
  (*f*) Rewind coil, insulate, moistureproof, and fungiproof.

(2) A relay winding meets its requirements but the spring assembly is badly damaged and a similar relay is in good condition except its winding is open. By using parts of the two relays, one good relay may be assembled to meet an emergency.
  (*a*) Remove spring assemblies from both relays. Note spring and insulating spacer arrangements.
  (*b*) Mount good spring assembly to relay structure having good coil winding.
  (*c*) See that the relay meets both mechanical and electrical readjust values given in relay chart figure 31 (par.45) before mounting the relay in the equipment.

39. Stripping and Adjusting

Repairs necessary to the switchboard, which are disclosed by checking visually and through other senses such as touch, hearing, etc., often can be accomplished without disassembly of the components. Certain parts may be found defective which can be easily removed, repaired, and replaced in the equipment. Directions for removing and replacing these replaceable parts are given in *a* and *b* below.

a. Relays. Failure of a circuit sometimes may be traced to particles of dirt or lint between contacts or to dirty parts of a relay. Covers are provided to reduce, as far as possible, the entry of foreign materials and the accumulation of foreign matter on the working parts of relays. Keep relay covers in place at all times, except when their removal is necessary for readjustment of the relay or for checking to see that it meets requirements. When replacing covers they should be right side up as determined by the designations on their covers so that no dirt or lint from the bottom of the cover will be deposited on any of the relay contacts and parts. When cleaning relays, always clean the inside of its cover with a lint-free cloth.

b. Switches. Switches are given functional designations which appear on circuit drawings and wiring diagrams. These designations are engraved either on the switch top or at a position on the equipment adjacent to the switch.

40. Cleaning

a. Equipment. Clean the equipment in a semi-inclosed booth and, if possible, equip the booth with a vacuum vent to take away the dust as it is brushed from the equipment with a fine camel hair brush. A turntable or equivalent, for ease in handling the equipment, is useful. Use probe sticks made of wood or insulating material for dislodging caked dirt and toothpicks, or their equivalents, from hard-to-reach places.

b. Cleaning Procedures.
  (1) Clean the outside of the equipment with a vacuum cleaner or cloth.
  (2) Remove dirt or salt spray with a cloth moistened with clear water. Let the equipment dry before attempting any further cleaning.
  (3) Remove the covers and see that they are marked properly so that they will be replaced correctly.
  (4) See that all covers are on relays and on other parts usually equipped with covers.
  (5) Brush the dirt from the equipment.

  Caution: Be careful when cleaning the inside of switch shelves and between contacts of switches. Apply the brush in such a way that dust is brushed away from the switch contacts.
  (6) Remove oil and grease with a cloth dampened with solvent (SD). Dry with a clean dry cloth.
  (7) Remove rust, corrosion, fungus, and similar foreign material in structural framework with fine sandpaper or a scratch brush, and clean with solvent (SD) where necessary.

41. Adjusting

a. Framework Assembly.
  (1) Inspect the framework for completeness in all parts. See that parts affecting structural strength are present and sufficiently rugged to withstand shipment

and ordinary handling. Be sure that none of the parts making up the framework are bent or distorted.

(2) Replace all missing or broken parts. Remove and straighten all bent parts, or, if this is impracticable, replace them. When parts are replaced, use the old parts as models for the replacements.

b. Covers and Protection Panels.

(1) *Inspection.* Inspect all covers. See that the parts fit without binding. If iron and wooden frameworks are out of line, straighten or replace them. If equipment has hinges, check the hinges for binding; if hinges are rusted, apply penetrating oil and work the hinge back and forth. Inspect removable panels. See that they fit and that they are not split or cracked. Repair or replace as required. If a part is replaced and is to be manufactured locally, use the old part as a model.

(2) *Switch removal and cleaning.*

(*a*) The adjustments outlined below require the removal of the switch from the switch shelf or panel. When the switch has been removed, inspect it for possible faults and make any adjustments necessary so that it will be in good working order when remounted.

(*b*) Remove the switch from the switch shelf as follows:

1. Raise the switch shelf, loosen the switch mounting screws, and shift the butterfly so that the switch can be removed. Force the switch slightly upward. Lower the switch shelf in place. Slowly raise the switch out of its position in the switch shelf. If interference is felt between the switch and an adjacent switch, do not apply force as this might damage the springs. Instead, remove the adjacent switch mounting screws and raise both switches high enough to permit the removal of the first switch without interference from the second. Then return the second switch to its position in the switch shelf. Raise the switch to be adjusted as far as the skinners will permit and support it, while making adjustments, by means of a 429A or 429B switch support or similar tool placed inside the lugs on each end of of the switch. When the adjustment has been completed, remove the switch supports, return the switch to its position in the switch shelf, and securely fasten it in position.

2. To remove a switch from the switch shelf when the switch shelf is equipped with retaining strips, remove the retaining strip screws and then remove both retaining strips. Remove the switch mounting screws and raise and support the switch.

3. To remove a switch from a switch shelf when the switch is mounted from the top of a switch shelf, remove the mounting screws and raise and support the switch.

(*c*) If there is evidence that a switch contact is not closed properly, this condition may be checked by bridging with a test receiver across the springs of the contact through which the current is flowing. Absence of clicks or fluttering in the test receiver indicates a satisfactory contact. If the contact is unsatisfactory and inspection shows that the switch is in mechanical adjustment, burnish it.

(*d*) Failure of a circuit is often traced to particles of dirt or lint between the contacts or to other dirty parts of the switch. If excessive dirt or dust has collected on or adjacent to the contact portions of the apparatus, remove it with the KS–2993 brush or the D–98063 cloth.

(3) *Pitted key contacts.*

(*a*) Pitted contacts do not always indicate that the contact must be replaced. Frequently the switch can be reconditioned by cleaning and/or burnishing, thereby meeting the contact follow and contact separation requirements.

(*b*) After cleaning or burnishing see that these requirements are met. Repeated burnishing tends to increase the contact separation and reduce the contact follow. Correct as necessary in accordance with procedures given. Wipe off any excess lubricant with a clean

dry cloth. If the hinge is bent, remove it and straighten it, or replace it if necessary.

c. Structural Metal Details.

(1) Inspect metal details (brackets, mounting bars, etc.) and remove all slivers and sharp burrs with a fine flat file.

(2) Remove rust, corrosion, and fungus on structural details with fine sandpaper or a scratch brush. Clean with solvent (SD) or equivalent.

Caution: Never use emery cloth or steel wool. Loose particles of steel wool or emery may sift into the equipment causing harmful shorting or grounding of circuits.

d. Wooden Details.

(1) Inspect woodwork for excessively warped parts, for splintered edges, open glued joints, splits, cracks, and breaks.

(2) Replace excessively warped parts as required. If the warped part is a detail of a complete part, remove the defective detail and reglue the new detail. If the new detail is manufactured locally, use the old part as a pattern. Protect the finish when placing the new part in a vise or clamps.

(3) Smooth and retouch all splintered edges. Use a wood plane and sandpaper.

(4) Reglue all loose joints with waterproof glue. Remove the old glue and spread the joint with a wedge, being careful not to split the part. Apply glue as far as possible into the open joint. Clamp the reglued joints.

(5) Repair splits and cracks with plastic wood or equivalent filler. If the split or cracks are large enough to affect the structural strength, replace the part. Sand all refilled holes and cracks.

(6) Remove screws from stripped wooden parts. Fill the holes with plastic wood and replace the screws immediately.

e. Miscellaneous Mechanical Details.

(1) *Screws, rivets, and bolts.* Inspect all screws, rivets, and bolts for looseness. Tighten any that are loose. Replace stripped screws, bolts, and nuts. Ring-stake and retap stripped threaded holes in all metals except aluminum. When the material cannot be ring-staked or is aluminum, redrill and retap for a larger screw or use a bolt, lockwasher, and nut. Replace all badly burred screws, bolts, and nuts which cannot be engaged or turned with a screw driver or wrench.

(2) *Rubber gaskets.* Check all gaskets and replace all broken sections. When making this repair, replace complete sections wherever possible. Use rubber cement or its equivalent as adhesive.

(3) *Bushings and rubber grommets.* Inspect insulating bushings and rubber grommets which protect wiring and cords. Replace those which are broken, aged, or brittle.

f. Cord Drillings and Plug Seats.

(1) Inspect cord drillings, and, if worn, replace the plug shelf if adjacent plugs touch each other.

(2) Inspect for loose or worn plug seats by lifting and lowering the plug in the plug seat. (A plug seat is the fiber holder under the switch shelf that prevents the cord from falling through the switch shelf of the switchboard.) Smooth all rough or chipped plug seat drillings to prevent excessive wear of the cords. Check the screws holding the plug seat to the key shelf and tighten any that are loose. Examine the plug bushings protecting the cords. Replace any that are cracked or broken.

Section V. TROUBLE SHOOTING

42. Definition

Trouble shooting consists of a series of operations designed to locate and correct faults occurring in the equipment, which cause break-downs, interruptions in service, or which render it wholly inoperative.

a. Trouble-Shooting Data. A knowledge of the functioning of the equipment and theory of operation is necessary to apply properly the technique of trouble shooting. Study the accompanying circuit description and schematic diagrams for an understanding of the operation of the various circuits. The trouble analysis chart will list the most common troubles that occur in SB–55(*) FTC together with a listing of the probable causes. There are no definite rules for an exact procedure because of the wide variation of possible troubles. Consult the following data when necessary:

(1) Complete schematic diagram (fig. 32).

(2) Simplified and partial schematic diagrams (figs. 11 through 16).

NOTE.—These simplified diagrams are useful in speeding trouble shooting, since the operator can follow the electrical functioning of circuits on them more easily than on a regular schematic.

b. TROUBLE-SHOOTING STEPS. The first step in trouble shooting is sectionalizing the fault. Sectionalizing means tracing the fault to the component or circuit responsible for abnormal operation of the equipment. The second step is localizing the fault to the defective parts of the component responsible for abnormal operation. Many faults may be located by using the senses (sight, smell, hearing, and touch). The majority, however, must be located by checking voltage, resistance, and continuity.

c. LOCALIZING ELECTRICAL TROUBLES. When testing and inspecting the Fire Reporting Switchboard, do not disturb the electrical circuits any more than is necessary. Most electrical troubles will be found in relays, in connections, at contacts in switches and jacks, or where insulation on wire or between metal parts has been damaged. Use a milliammeter, voltmeter, or ohmmeter to prove the location of electrical trouble. Refer to the schematic and wiring diagrams and to functional diagrams. Make point-to-point tests until the fault is located.

d. LOCALIZING MECHANICAL TROUBLES. When a mechanical function fails or operates in a faulty manner localize or isolate the trouble by making a particular adjustment or a series of adjustments. Two methods are used. The operator's experience and the over-all condition of the equipment indicates which is the better approach. The first method requires the operator to check the individual requirements for all adjustments in the subassembly or mechanism. Use the related detail and adjustment procedures to determine the sequence to be followed. The second method may short-cut the task of localizing mechanical troubles. Reference is made to the technical manuals covering the various components of the switchboards. Additional aid in locating mechanical troubles often may be secured from station records showing previous troubles and adjustments.

e. EQUIPMENT PERFORMANCE TEST. The equipment performance checklist (par. 16) frequently indicates the general location of trouble. Perform the steps given in the checklist in sequence until an abnormal result is obtained. As each step is performed note the visible and audible results of the action.

43. Trouble-Shooting Chart

The following chart, if properly used, will simplify trouble shooting. This chart lists the various symptoms which may be recognized easily by the operator, and gives the probable location of the existing trouble as well as the recommended correction. By using this chart the repairman can isolate the trouble to one particular part of the equipment, and thus save time that otherwise would be lost in checking components that are free of trouble.

Symptoms	Probable troubles	Corrections
1. Operator cannot hear	Open in receiver circuit of operator's telephone.	Repair telephone.
	Capacitor T open	Replace capacitor.
2. Operator cannot be heard	Open in transmitter circuit of operator's telephone.	Repair telephone.
	Capacitor, 4 mf, open	Replace capacitor.
3. LO lamp fails to light	Defective lamp	Replace lamp.
	Break-made contact of relay LO defective.	Repair relay LO.
	Relay 13 defective	Repair relay 13.
	Battery connections loose	Tighten terminals.
	Open in cable or associated switchboard wiring.	Check for defective wiring.
4. Line lamp fails to light	Defective lamp	Replace lamp.
	Make contact 2 of relay ER defective	Repair relay ER.
	Battery connections loose	Tighten terminals.
	Relay 10 defective	Repair relay 10.
	Open in cable or associated wiring	Check for defective wiring.

43. Trouble-shooting Chart—Continued

Symptoms	Probable troubles	Corrections
5. Annunciator lamp does not operate.	Contact 1 on relay A defective	Repair relay A.
	Ground connection on release switch loose	Check ground connection.
	Battery connections loose	Check battery.
	Defective lamp	Replace lamp.
6. Supervisory lamp does not operate.	Battery connections loose	Check battery.
	Defective lamp	Replace lamp.
	Break contact of relay S defective	Check relay S.
	Short in cord or cord plug	Repair or replace the cord or cord plug.
	Defective cable or associated wiring	Check for defective wiring.
7. LO lamp on switch shelf fails to operate.	Defective lamp	Replace lamp.
	Battery connections loose	Check battery.
	Break contact of relay P defective	Repair relay P.
	Ground connections loose	Tighten ground connections.
	Dirty or defective jack contacts	Clean, repair, or replace jack.
	Open in cable or associated wiring	Repair open.
	Short in cord or plug	Repair or replace the cord or cord plug.
	Main battery fuse open	Replace fuse.
8. Operator cannot hear on one cord circuit.	Open in cord or plug	Repair or replace the cord or cord plug.
	Defective TALK-RING switch.	Repair switch.
9. Operator cannot be heard on one cord circuit.	Open in cord or plug	Repair or replace the cord or cord plug.
	Defective TALK-RING switch	Repair switch.
	Dial cord open or shorted	Repair or replace the dial cord.
10. Operator cannot dial	Dial defective	Repair or replace dial.
	Open in relay 2	Repair relay 2.
	Battery connections loose	Tighten terminals.
	Trunk switches not making proper contact	Clean, repair, or replace switches.
	Defective wiring in associated circuits	Check for open or shorted wiring
11. Night alarm bell does not operate.	Defective bell	Replace or repair bell.
	Night alarm switch in OFF position	Put switch in ON position.
	Common connection to night alarm grounded.	Remove ground.
	Make contact of relay 10 defective	Repair relay 10.
	Battery connections loose	Tighten terminals.
12. No ringing current on one cord circuit.	Defective cord or plug	Repair or replace cord or plug.
	TALK-RING switch defective	Repair switch.
13. No ringing supply on all cord circuits.	AC power failure	Check AC supply.
	Generator switch contacts not making	Repair contacts.
	Defective ringing machine	Repair ringing machine.
14. No ringing current on all cord circuits from hand generator.	Hand generator defective	Repair or replace hand generator.
	Generator switch contacts making	Repair switch.
15. Neon lamp glows continuously.	TALK-RING switch contacts not making properly.	Repair or replace switch.
	Ringing leads shorted	Repair leads.
16. Power failure lamp does not light.	Defective lamp	Replace lamp.
	Power failure	Check batteries or main fuses.
17. Operator is unable to hold a trunk circuit.	Trunk switches not making contact	Repair, or replace trunk switch.
	Open in cable or associated wiring	Repair defective wiring.
18. Green trunk lamp fails to light.	Defective lamp	Replace lamp.
	Contact 2 on relay 5 not making	Repair contacts.
	Battery connections loose	Tighten terminals.
	Ground connection faulty	Tighten ground connections.
19. LO alarm fails to operate	Defective alarm	Replace alarm.
	LO alarm switch open	Close LO alarm switch.
	Make contact on relay 13 not making	Repair relay.
	Generator switch contacts not making	Repair switch.
	Cable and associated wire defective	Repair wiring.
20. All lamps and relays fail to operate.	Main fuse open	Replace fuse.

Section VI. APPARATUS ADJUSTMENT AND FINAL TESTING

44. Relay Adjustments

a. Basic Design. Relays of the No. 2000-type are electrically operated switches used in various trunk, line, cord, and miscellaneous circuits of Telephone Switchboard SB–55 (*)/FTC for the purpose of controlling signaling, talking, and associated circuits. The relay (fig. 17) is an electromagnet consisting of an iron core and frame which supports a coil of wire W, one or more sets of contact springs S, and an armature A.

b. Framework and Magnetic Circuit. The iron framework of the relay (fig. 18) consists of an iron core with one end threaded to form a mounting stud, the heel iron which supports the springs (fig. 17), and the armature which is attracted to the core and operates the springs each time the electric circuit is closed through the winding (symbolized by a single wire in fig. 18).

c. Relay Armatures.

(1) *Types.* There are two types of armatures. One type (fig. 17) is designed to control 1, 2, or 3 sets of springs. The other is a special lightweight type with a narrow top (fig. 19) designed for only one set of springs. All armatures are provided with insulating stops (figs. 18 and 19), one tip for each pile-up of springs. These stops are made of insulating material and support and operate the level springs. The armatures are held centered in place by the stud screw and self-locking nut (fig. 18).

(2) *Residual pins and screws.* Soft iron is used for relay cores, heel irons, and armatures because in most cases it promptly loses its magnetism and the armature immediately releases when the relay control circuit is open. Because it is difficult to eliminate all impurities or because the steel mounting plate may be magnetized, temporarily, relays subject to heavy current surges or relays which remain operated over long periods, may develop a small amount of residual magnetism, (termed as such because it does not dissipate promptly when the relay circuit is opened). This residual magnetism may cause armature in direct contact with the core to stick or freeze and not release

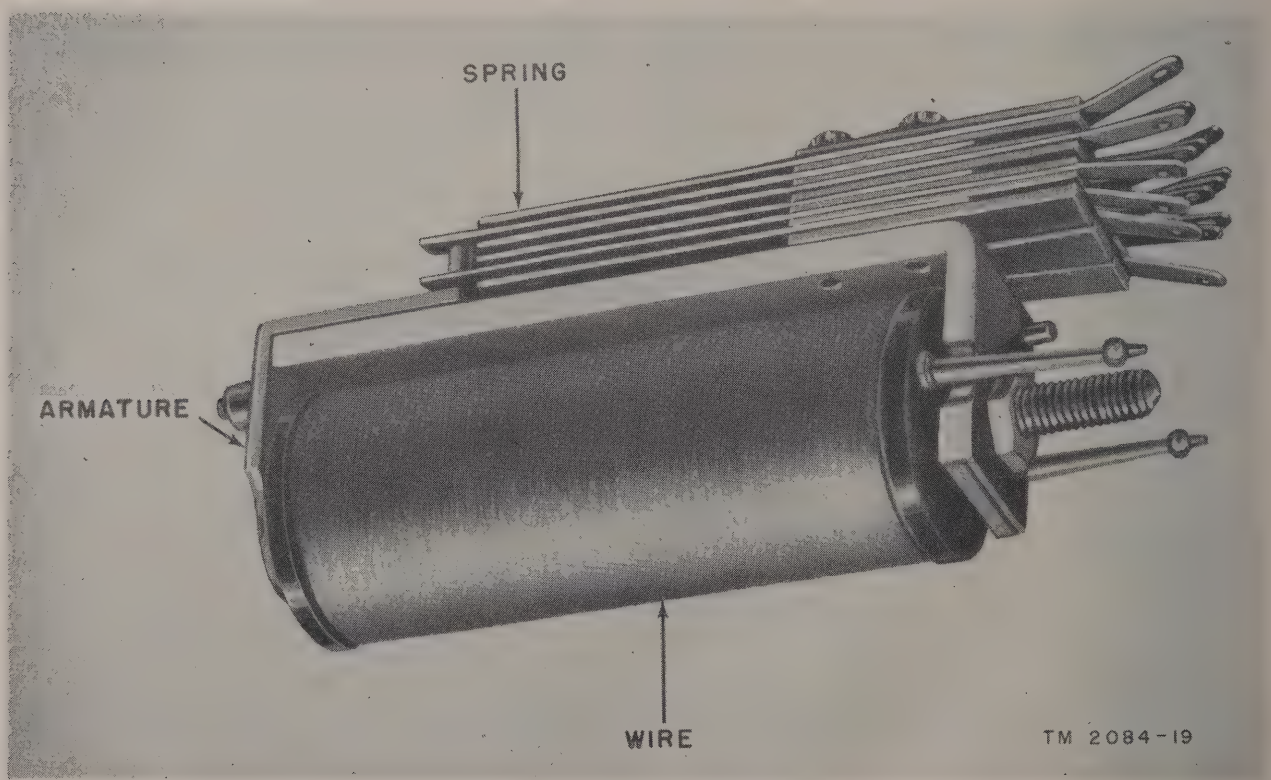


Figure 17. No. 2000-type relay.

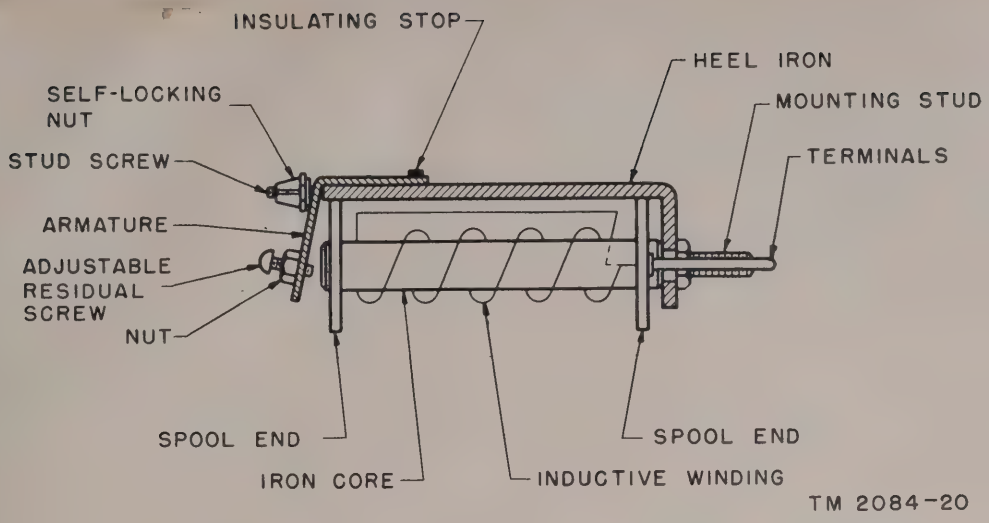


Figure 18. Framework diagram of 2000 relay.

promptly, thus seriously interfering with associated circuit operations. Such trouble is avoided by the use of a fixed residual pin or an adjustable brass screw, that prevents the armature from directly contacting and freezing to the core. A fixed residual pin (figs. 19 and 20) is riveted to the armature opposite the center of the iron core and usually projects 0.010 inch. Other armatures are equipped with an adjustable residual screw (fig. 18) which is locked in position by a nut.

d. Contact Springs.

(1) *Spring design.* Contact springs are made of semihard silver-nickel or some other metal alloy, and are provided with special contact points made of precious metal which is used because of its high conductivity and resistance against arcing. These contacts (fig. 24) are pointed as on the break spring, or are flat disks as indicated on the make spring. A lever spring contact is pointed on the upper side and flat on the lower. The combination of a point on one spring and a flat surface on the opposite spring tends to make a solid and self-cleaning contact. The flat contact is placed on the under side of the spring because it does not collect dirt so readily in this position.

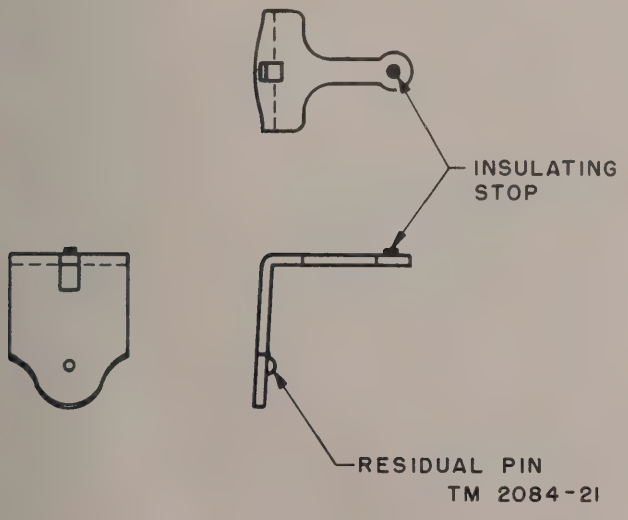


Figure 19. Armature diagram.

(2) *Break-before-make spring sets.* An armature of lever springs and its associated make-or-break contacts provides a unit set or combination. Two or more unit sets mounted one above the other are known as a pile-up. The set in figure 20 consists of a break spring or contact, a lever spring which ordinarily rests in contact with the break spring, and a make contact. The operation of the armature lifts the lever spring, breaking its contact with the break spring and closing its contact with the make spring (fig. 21). The combination is known as a break-make set.

(3) *Other spring combinations.* Another spring set (fig. 22) provides make-before-break contacts. In this case, the lever spring makes contact with the make spring before the make spring breaks with the break spring. Figure 23 shows a pile-up

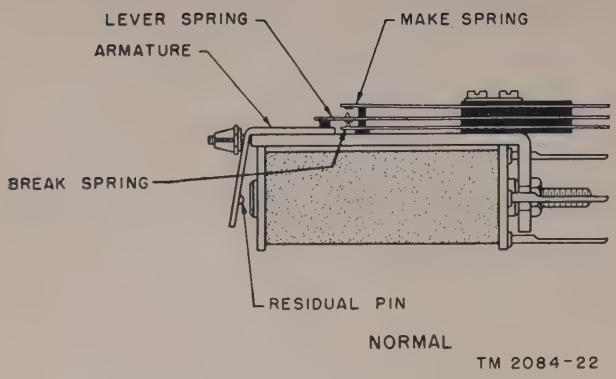


Figure 20. No. 2000 relay, side view.

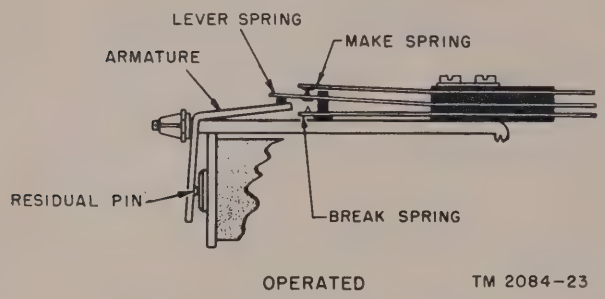


Figure 21. Relay in operated position.

with two sets of break-make contacts, one above the other; these contacts are controlled respectively by two lever springs which operate in unison because of the connecting insulator carrier bushing. The simplest spring combination consists of two springs, a lever spring, and one associated break or make contact.

(4) *Spring stops, bushing, and insulation.* The insulation stop on the armature prevents grounding of the lever spring on the relay frame. It is also necessary to insulate each spring from the others and from the frame. Figure 24 shows a

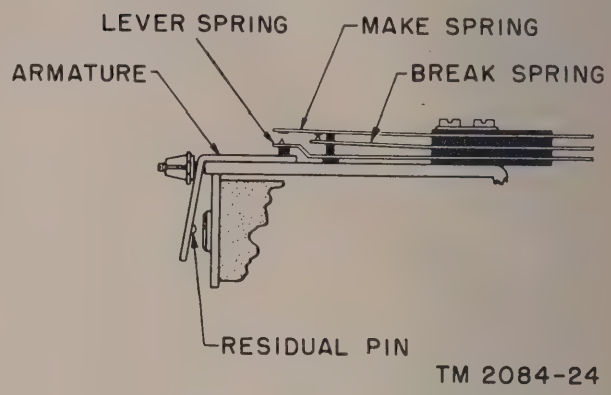


Figure 22. Make-before-break springs.

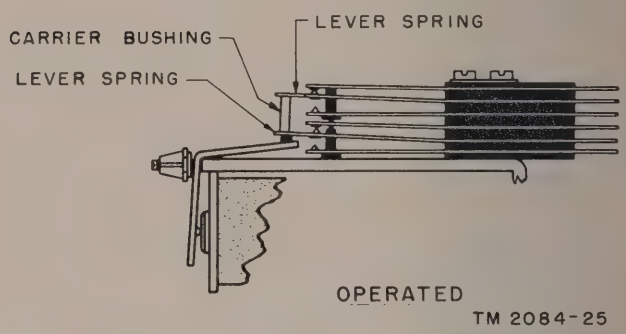


Figure 23. Double spring pile-up, operated.

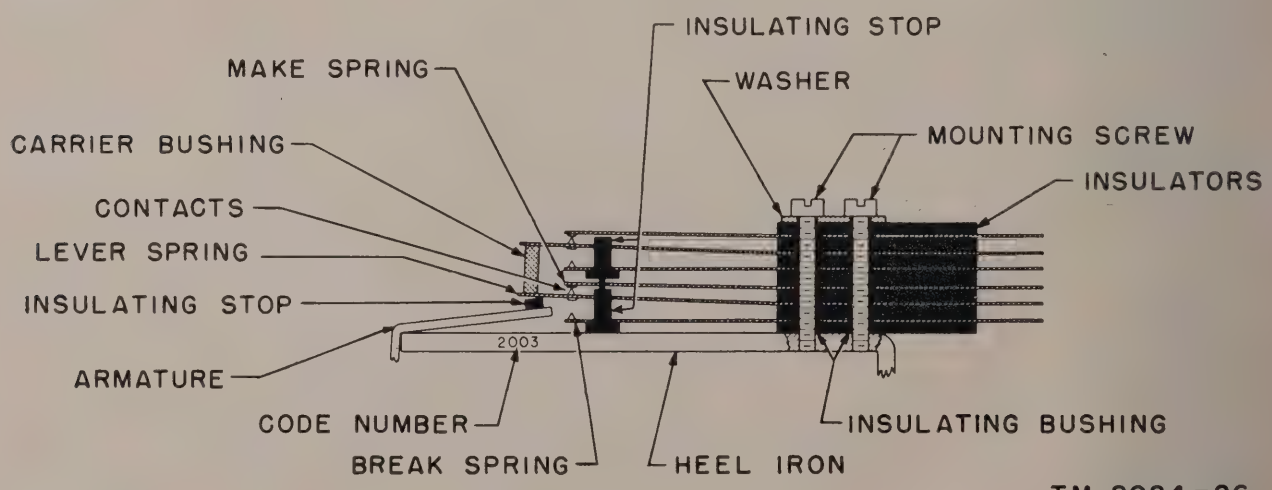


Figure 24. Double spring pile-up, cross-section

cross-section view of a set of springs, their stops, and their insulating parts, so as to illustrate how the springs are assembled, insulated, and mounted.

(5) *Multiple pile-ups and circuit symbols.*

(*a*) *Identifying and locating pile-ups.* The relay heel plate is wide enough to support and operate three sets or pile-ups as indicated in figure 25. Viewed from the armature end of the relay these pile-ups are lettered A, B, and C from left to right.

(*b*) *Numbering spring sets.* A set of two or three springs constitutes a spring operating unit and is so numbered in wiring diagrams. These spring units are numbered from right to left on relays as viewed from the armature end or from left or right as viewed from the terminal wiring end. Figures 25 and 26 show the method of numbering two or three spring pile-ups on this basis. Note that the three sets in the bottom row are numbered 1, 2, and 3 and that the next row above is numbered 4, 5, and 6. All spring combinations for 2000-type relays are included on drawing 23600, supplied with each installation.

(6) *Relay mounting plates and covers.* Steel mounting plates provide a support for banks of relays mounted in pairs or in larger groups. Metal covers offer protection from mechanical injuries, dust, moisture, and gases. For individual relays or these mounted in pairs, they prevent inductive disturbances between supervisory relays in talking circuits. The relay core is threaded at one end for mounting purposes. The heel iron is provided with a small alining pin which fits into a corresponding hole in the mounting plate and thus holds the relay rigidly in place. The relay terminals pass through holes in the mounting plate which are lined with insulating bushings to prevent grounding the terminals.

(7) *Relay coils.*

(*a*) *Inductive windings.* An inductive relay winding (fig. 17) consists of a relatively large number of turns of insulated wire, generally copper, wound in layers, one above the other on the core like thread on a spool. They are called *inductive winding* because current flowing through the wire magnetizes the core and heel iron for actuating the armature.

(*b*) *Single windings.* Single winding consists of wire wound over a tube of insulating paper wrapped directly on the core. The winding, symbolized in figure 18 by a single wire, is held in position by phenolic fiber washers or spool ends, mounted as indicated. Both ends of a coil are brought out through the washer and soldered to an external pair of terminals located at the mounting end of the relay as indicated.

(*c*) *Double windings.* A second inductive winding is sometimes used and generally is wound over the first. These are called *concentric windings.* Sometimes two one-half length coils are placed end

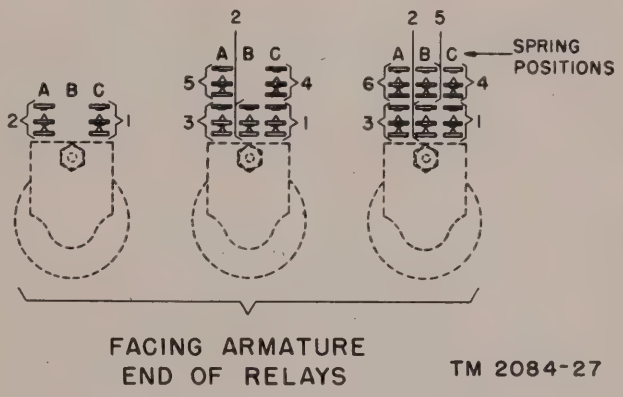


Figure 25. Spring pile-up, front view.

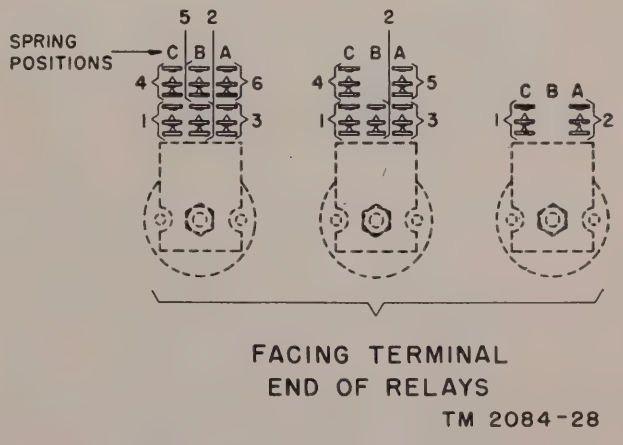


Figure 26. Spring pile-up, rear view.

to end. This method is called *tandem winding*. Two wires may be wound side by side producing a parallel winding.

(*d*) *Noninductive windings.* These windings consist of two wires soldered together at the inner end and then both wound simultaneously. The two other ends are soldered to terminals as usual. Because one-half of the winding produces one magnetic polarity and the other half the opposite polarity, these windings magnetically neutralize each other and thus provide a noninductive resistance which, when wound on the same relay with an inductive winding, does not affect armature operations. German silver wire, which has a high resistance as compared with copper, generally is used for this purpose, as fewer turns and less space is required.

(*e*) *Resistance and retard coils.* Relay cores sometimes are used as a convenient method of supporting noninductive resistances or inductively wound retard coils. Iron shells sometimes are placed over retardation coils to prevent them from inductively affecting adjacent relays or coils.

(8) *Code numbering.*

(*a*) *Spring combinations.* Relays of the No. 2000-type are identified by four-digit code numbers with associated prefix and suffix letters. The last three digits, such as 004 or 036 of a four-digit code number 2004 or 2036, indicate the types of spring combinations. These numbers are stenciled on one edge of the heel iron (fig. 24).

(*b*) *Armature types.* A number with the prefix B (B2004) indicates a relay with an armature having a fixed 0.0025-inch high residual pin. The prefix F indicates an armature equipped with an adjustable residual screw. Code numbers without the prefix S or F indicate armatures with fixed 0.010-inch residual pins.

(*c*) *Windings.* The first suffix letter such as S in a relay code number (2004S) indicates the type of winding. For example—

S—indicates a single winding.

T—indicates two tandem windings (*d*(7) (*d*)).

P—indicates two parallel inductive windings.

NOTE.—Noninductive windings wound on the same core with inductive windings are not identified by a suffix letter. Relay cores are used for mounting resistance or retardation coils and are identified by their own series of code numbers.

(*d*) *Resistances.* A second suffix letter R as in a relay code number 2004SR, or a second and third suffix letter such as AP in 2004SAP, refers to the resistance of the winding or windings to which the codes are assigned as well as to the kind of core, copper sleeve, or slug, etc.

(9) *Installations and replacements.*

(*a*) Use socket wrenches instead of pliers to remove and replace nuts on mounting screws or bolts; use specified tools for making armature and spring adjustments.

(*b*) Tighten mounting screws or nuts without using enough pressure to twist or break the screws.

(*c*) Be sure that relay covers are cleaned before removing them. Promptly replace and fit covers.

(*d*) Be careful when disconnecting and reconnecting wires so as not to break them, burn the installation, or leave loose connections.

(10) *Spring contact spacing and tensions.*

(*a*) *General.* The following illustrations and descriptions supply basic principles for contact separation, range of spring movements, and spring tensions which which supplement information in relay tables. These practices generally are applicable to all other spring assemblies, except when specified differently for special relays or conditions.

(*b*) *Relay contact spacing.*

1. *Break-before-make spring assemblies.*

(a) *Make-contact spacing* (*fig. 27*). To to insure effective spring operations, it is necessary for the lever spring to move 0.005 to 0.010 inch to contact the make spring, which means that the separation between the lever spring and the make spring contacts is likewise nor-

mally 0.005 inch to 0.010 inch as indicated. After the lever spring contacts the make spring there should be a follow-up motion of at least 0.003 inch for both the lever and the make springs in order to lift the make spring from its stop, thus insuring a solid make contact.

(b) *Break-contact spacing.* The break contact (fig. 27) rests solidly on the stop and does not move. The lever spring, therefore, separates from the break contact by approximately 0.005 to 0.010 inch when fully operated (fig. 28). The lever spring in its nonoperated position should have a perceptible separation of at least 0.002 inch from the armature stop or lever springs; this insures a solid nonoperated contact on the break spring.

2. *Single break or make assemblies.* A break-only contact unit is designed the same as the break-make in figure 27 except that the make spring is omitted. In a make-only contact, the bottom spring minus its contact is retained to hold the insulating stop in position. Note that the upper portion of the stop is used to support and maintain the make spring in its nonoperated position, otherwise the open contact spacing and lever spring movement is the same as in a break-make assembly.

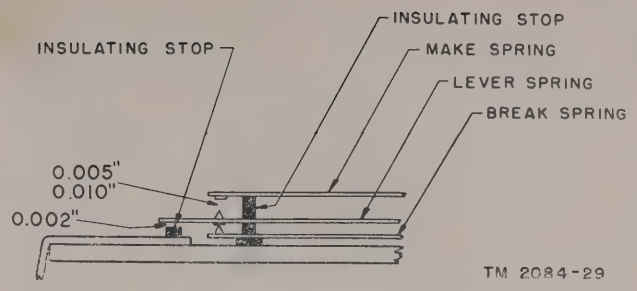


Figure 27. Make contact spacing, normal position.

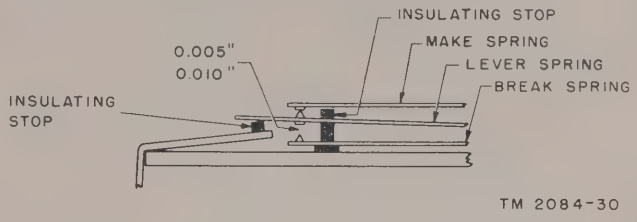


Figure 28. Break contact spacing, operated position.

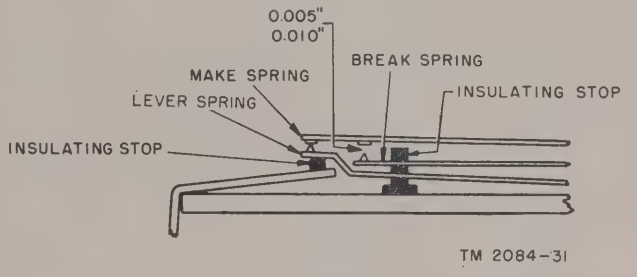


Figure 29. Make-before-break spring, operated position.

3. *Make-before-break assembly (fig. 29).* The make-and-break springs are normally in contact. The operating lever spring contacts the make spring before the make spring breaks from the break spring. The lever spring

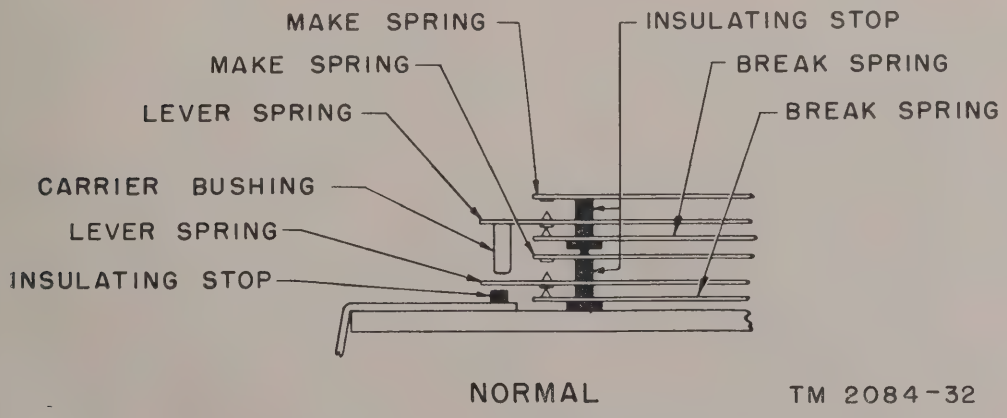


Figure 30. Multiple spring stack, normal position.

normally rests on the armature stop with the specified tension and with a contact separation from the make spring of approximately 0.005 to 0.010 inch. The operated contact of the make spring has the same separation.

4. *Multiple unit stacks* (*fig. 30*). The preceding rules apply to these assemblies. For example, the lever spring normally should be separated from the carrier bushing as it is from the armature stop when there is a break contact. When there is no break contact, the lever spring should be tensioned against the bushing.

5. *General rules.* Unless otherwise specified in relay tables, the foregoing rules apply. They are summarized as follows:

(a) A break contact normally rests solidly with prescribed tension on its stops, and does not follow the operating lever spring.

(b) A make contact normally rests solidly on its stop with the prescribed tension, but does not follow or lift from the stop by more than 0.003 to 0.005 inch after the operating lever spring makes contact.

(c) There should be a minimum of 0.005 inch separation between any pair of open contacts and at least the same separation along the entire length of any pair of adjacent springs.

(d) The lever spring should rest solidly with the prescribed tension against a break contact, with a separation of at least 0.002 inch from the armature stop. When there is no break contact, the lever spring should rest on the armature stop. The operating lever spring must move from a minimum of 0.005 inch to a possible maximum of 0.013 to 0.015 inch.

(11) *Spring tensions.*

(*a*) *General.* The contact pressure of tension on relay springs is measured in grams as read on a gram gage. Because some relays have many springs and others just a few, each spring must have a specified amount of tension when the springs are adjusted or readjusted so that the relay will function properly. The spring tensions, which are listed under *Mechanical Requirements* in the relay tables, represent the amount of pressure required to lift a lever spring from its nonoperated position. The same tension is applied to all other lever springs on the same relay so that if there are three assemblies on one armature (fig. 25), and the specified tension is 20 grams, the total pressure required by the armature in lifting the three springs will be at least 60 grams. If, for example, the required spring tension is listed as 20 grams for each lever spring, this tension is applied against the break contact, and it is the general practice for all break-and-make springs to be given the same tension against their stops. When there is no break contact, the lever spring is given the required tension against the armature stop. Before making spring readjustments be sure that springs are vertically in line and are parallel with the side of the heel iron; also be sure that mounting screws are tight. Use an offset screw driver for this purpose.

(*b*) *Standard rules.* There is a relation between armature travel and spring tension to be used on special relays or where spring tension is not specified, as follows:

Spring Tension for Armature Travel

10 to 15 grams	0.010″ to 0.015″
15 to 20 grams	0.015″ to 0.020″
20 to 25 grams	0.020″ to 0.025″

(12) *Cleaning*

(*a*) *Prevention.* Lint and other small airborne particles often lodge on contacts which have become dirty or carbonized and thus cause contact or armature trouble. For this reason, regular preventive cleaning is advisable. It also is advisable to clean relays indicating open contacts or to clean contacts before readjusting to meet mechanical or electrical operating requirements.

(*b*) *General cleaning.* Use a suction type vacuum cleaner to clean relay covers and adjacent equipment; follow this operation by wiping with a dust rag; this will remove dust and other particles that can cause trouble if dislodged by the removal of the covers. The same procedure should be applied to the inside of covers and to dust settled on relay windings.

Caution: Do not use an oil rag.

(*c*) *Cleaning relay armatures.* Sticky deposits on pole pieces can be removed with a small strip of hard-surfaced bond paper. Insert this paper between the armature and pole piece, operate the armature lightly with the finger and withdraw the paper under this pressure, repeating until the pole piece is thoroughly clean.

(*d*) *Cleaning contacts.* Dirty contacts can be cleaned best with a burnishing tool. Wipe the blade of the burnisher with a clean lint-free cloth before the burnisher is applied. Clean the burnisher occasionally with a cloth moistened in carbon tetrachloride. Clean the contacts which have a noticeable accumulation of dirt with carbon tetrachloride. Apply the carbon tetrachloride sparingly with a toothpick, and then burnish the contacts. Too much carbon tetrachloride may cause trouble. After dirt is removed, wipe off contacts with a dry toothpick or hard-surfaced bond paper, being particular to clean out pitted or worn spots on the contact. When burnishing normally open contacts, apply pressure to the spring with a tweezer or a pointed stick. Moving the burnisher back and forth two or three times with slight pressure on the contact spring, should be sufficient. When cleaning normally closed contacts, the tension of the contact springs can be increased in a similar manner. Clean pitted contacts and then polish them smooth with a burnisher. If the contacts are too deeply pitted, replace the spring. When cleaning contacts, check for spring tension, because a contact with too little pressure will not wipe itself clean.

Caution: Do not touch springs or contacts with fingers.

(13) *Adjustments.*

(*a*) *Armature adjustments.* Range of lever spring and armature movement is determined primarily by armature spacing, which should be checked before making spring readjustments. Decreasing this space will strengthen armature pull, but it will decrease lever movement. Armature adjustments of this nature are seldom, if ever, required, except to compensate for changes in residual height which may be made to overcome a developing residual magnetism. The distance between the end of a residual pin or screw and the pole piece can be measured best with a gage. Changing is required rarely, but, if necessary, remove the armature and bend it slightly at the angle, using a pair of No. 79 parallel-jawed pliers. When using the pliers, apply pressure evenly to avoid twisting the two wings out of line at the angle. Avoid breaking insulation stops. When replacing an armature, tighten the self-locking nut (fig. 18) on the supporting stud until the armature just begins to move. Then back the nut slightly so that the armature operates freely without binding and yet fits closely enough to the end of the heel iron to avoid play. The upper wing should lie flat on the heel plate without rocking.

(*b*) *Residual screws.* Residual screws are factory-adjusted to meet standard operating requirements or those requirements generally specified in the *Remarks* column on relay tables. Readjustments may be necessary to insure prompt release of a relay to compensate for wear and to control speed of armature operations on relays used in busy tone, ringing, or code interrupter circuits. A high screw increases speed or release while a low screw decreases it. Armature spacing may have to be changed as a result of residual screw readjustments. Make readjustments with the No. 77 socket wrench. The height of the screw is

determined by holding the armature against the pole piece and measuring distance in thousandths of an inch with a leaf gage.

(c) *Spring adjustments.*

1. *Adjusting spring tension.* Spring tension requirements are shown in terms of gram pressure in relay tables. The gram rating specified is the minimum required to produce sufficient contact pressure to keep the contacts clean and to prevent arcing and pitting. These pressures may be increased, if needed, to meet specified current-flow operating requirements. The tension tests are made by applying the gram gage as near as possible to the contact of the spring being tested. The spring should not break contact before its required gram pressure is indicated on the gage. To change spring tension, use No. 58 or 60 Kellogg spring adjusters and apply close to the fixed end of the spring (fig. 30). Ordinarily only a slight pressure is needed. Duck-billed pliers with the ends filed thin and parallel can be used as a substitute adjuster when springs are accessible from the side. Too much or too frequent bending tends to crystallize the spring and destroy its flexibility.

2. *Straightening springs.* If the spring is not straight or if there is not enough separation between springs, correct the condition by adjusting the spring where it is bent or distorted. All springs should be free of sharp bends or kinks. A slight bow or a small bend, however, at the end of the spring sometimes is permissible when needed to secure proper contact adjustment.

45. Final Testing

a. Purpose. After making repairs or adjustments on any of the circuits of Telephone Switchboard SB–55*/FTC, operational tests should be made in order to check for continuity, correct polarity, absence of shorts and grounds, and high insulation resistance.

b. Test Equipment. Test Set TS–26/TSM is recommended for use in checking wiring or apparatus for continuity, opens, battery, or ground. A buzzer or meter may be used if desired.

Note.—For relay settings and ratings refer to the relay adjustment chart (fig. 31).

46. Operational Tests

a. Connect test equipment to a line.

b. Check ringing, transmission, and supervision on each cord.

c. The S lamp should flash when the switchboard is operated and released.

d. The LO lamp should flash when the line is opened and closed.

e. Check the operation of the night alarm, LO alarm, ringing signal lamp, power failure alarm, hand generator, and generator switch.

f. Call in from the telephone connected to the line being tested, through the test equipment, thus lighting the line lamp.

g. Operate the hookswitch and check to see that the line lamp goes on and off.

h. Answer to call, check the quality of transmission, hang up, then ring on the line.

i. See that the annunciator lamp lights.

j. Operate the annunciator release key, extinguishing the annunicator lamp.

k. Flash the LO lamp.

l. See that covers of the A and LO relays do not touch the contacts of the relays.

m. Check fuse posts for crosses with each other and grounds.

n. Check continuity from ground to relay mounting strips, switch frame, and jack frame.

o. With trunk and cord switches normal, see that the P terminal of the 72–A induction coil is not grounded.

p. For wiring diagrams and detailed explanations for testing various circuits in common battery switchboards, refer to figure 32 and also TM 11–4312.

Section VII. REFINISHING

47. Appearance

a. General. Check all metal surfaces for appearance and condition. From a protective and durability standpoint, the finish should show no decided wear and should not be chipped or damaged otherwise. Where the metal finish has been removed completely or has worn thin, or

APPARATUS LIST AND RELAY TEST (48-V OPERATION)

CIRCUIT 41637

COMP NO.	CODE NO.	COIL RESISTANCE	MECHANICAL REQUIREMENTS			TERM.	HOLD	AFTER SOAK	DIRECT CURRENT FLOW IN AMP						REMARKS
			CONT PRESS	ARM. TRAVEL	RESIDUAL HEIGHT				TEST			READJUST			
									OPN	NON OPN	RY	OPN	NON OPN	RY	
ER	579-D	500Ω 2000Ω		0.020		182			0.030	0.0115		0.028	0.012		700Ω EXT SUB LOOP 20,000Ω LEAK 44-50V
LO	2102-S-JF	70Ω		0.010				0.029	0.010		0.0025	0.0095		0.003	
A	2037-TY	1000Ω 1000Ω	20-G	0.020		182			0.034			0.014			
P	2102-S-JF	70Ω		0.010				0.150	0.010		0.0025	0.0095		0.003	
R	NO. 56-B RET COIL	200Ω 200Ω													
S	2102-S-JG	35Ω		0.015	0.010			0.150	0.035		0.014	0.034		0.015	
1	D-2030-S-AQ	1000Ω	20-G	0.020					0.034			0.007			
2	D-2019-S-AQ	1000Ω	20-G	0.020					0.034			0.015			
3	2-NO:64-C CAPACITORS	EACH 2MF													
4	NO 64-C CAPACITOR														
T	NO. 64-C CAPACITOR														
R	NO. 64-C CAPACITOR														
5	D-2056-C-FE CAPACITOR	1000Ω 310Ω		0.020	0.012	182			0.014	0.009		0.013	0.010		TOP SPRING 0.010 TO 0.015G
6	S-CT COIL	200Ω													
7	S-DJ COIL	50Ω													
8	NO. 64-C CAPACITOR SPEC. IMF														
10	2102-S-HG	3.5Ω		0.010				0.150	0.037		0.0015	0.022		0.002	
16	2001-S-X	1500Ω	20-G	0.020					0.027			0.005			
13	2102-S-HG	3.5Ω		0 010				0.150	0.037		0.0015	0.022		0.002	
	WORKING LIMITS														
	LINE AND CORD CIRCUIT — MAX CONDUCT LOOP RESISTANCE 700Ω														
	MIN INSULATION RESISTANCE 20,000Ω														
	RINGING RANGE FROM PBX (20∿ SIG)														
	TRUNK CIRCUIT					72-V		80-V		84-V			95-V		
	MAX CONDUCT LOOP RESISTANCE					3000Ω		3500Ω		3700Ω			4400Ω		
	MIN INSULATION RESISTANCE 20,000Ω														
	THE WORKING LIMITS OF TRUNK CIRCUIT WITH A CONNECTING PBX IS CONTROLLED BY THE WORKING LIMIT OF THE PBX														

NOTES:

1. USE READJUST CURRENT FOR INITIAL ADJUSTMENTS.
2. USE TEST CURRENT FOR ROUTINE CHECKING AND INSPECTION.
3. USE READJUST VALUES IF RELAYS FAIL TO MEET TEST REQUIREMENTS.
4. APPLY SOAK CURRENT WHEN SPECIFIED BEFORE TESTING OR READJUSTING.

TM 2084-41

Figure 31. Relay adjustment chart.

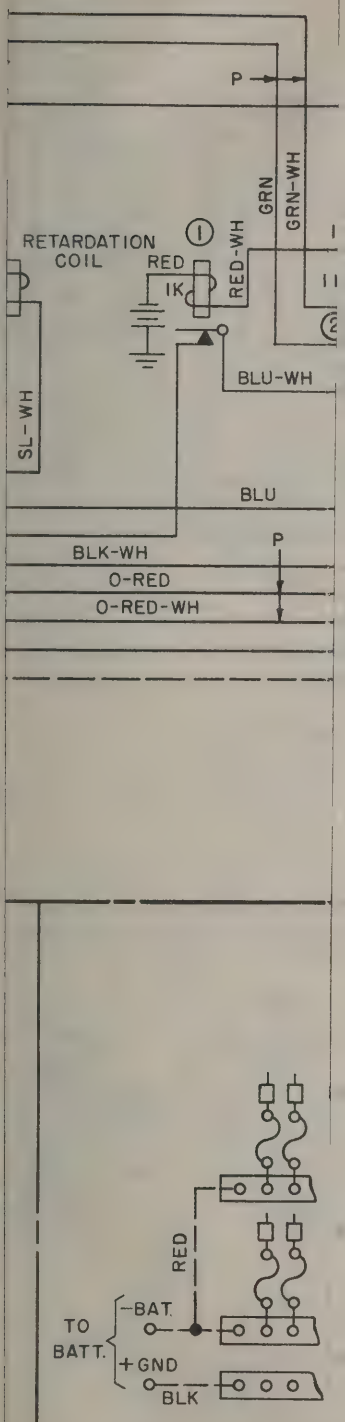
where it has been removed as a result of sanding or scratch brushing, retouch such surfaces if they cover only small areas. If the damaged or bare spots cover large areas, completely refinish the entire part. Slightly discolored, spotted, faded, or stained surfaces are permissible, provided the original finish is intact.

b. Finishing Procedure. After sanding or scratch brushing, retouch damaged surfaces by applying one coat of clear lacquer to parts having a bright finish, such as zinc- and nickel-plated surfaces; apply one coat of matching enamel or paint on painted surfaces. Do not apply lacquer on contact points of switches, parts of springs, or other surfaces which might affect the functioning of the switchboard. Also refer to TB SIG 13.

48. Wiring

Examine wiring and make sure it is in good condition. Slightly scarred outer covering is satisfactory, but if the outer insulation is broken or cracked, replace with new wiring.

Caution: Never change the length of skinners. Be careful when making soldered connections. A slight amount of excess solder dropped inside the equipment may cause short circuits.



BATTERY ALAR

ete schematic diagram

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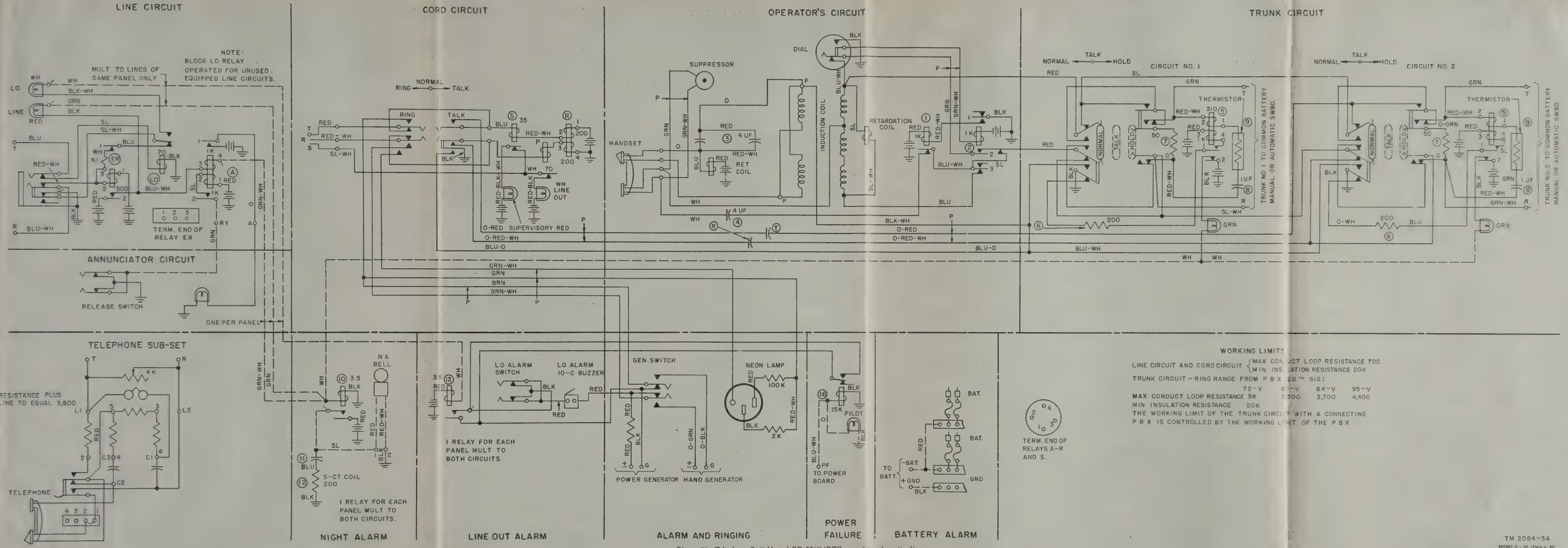
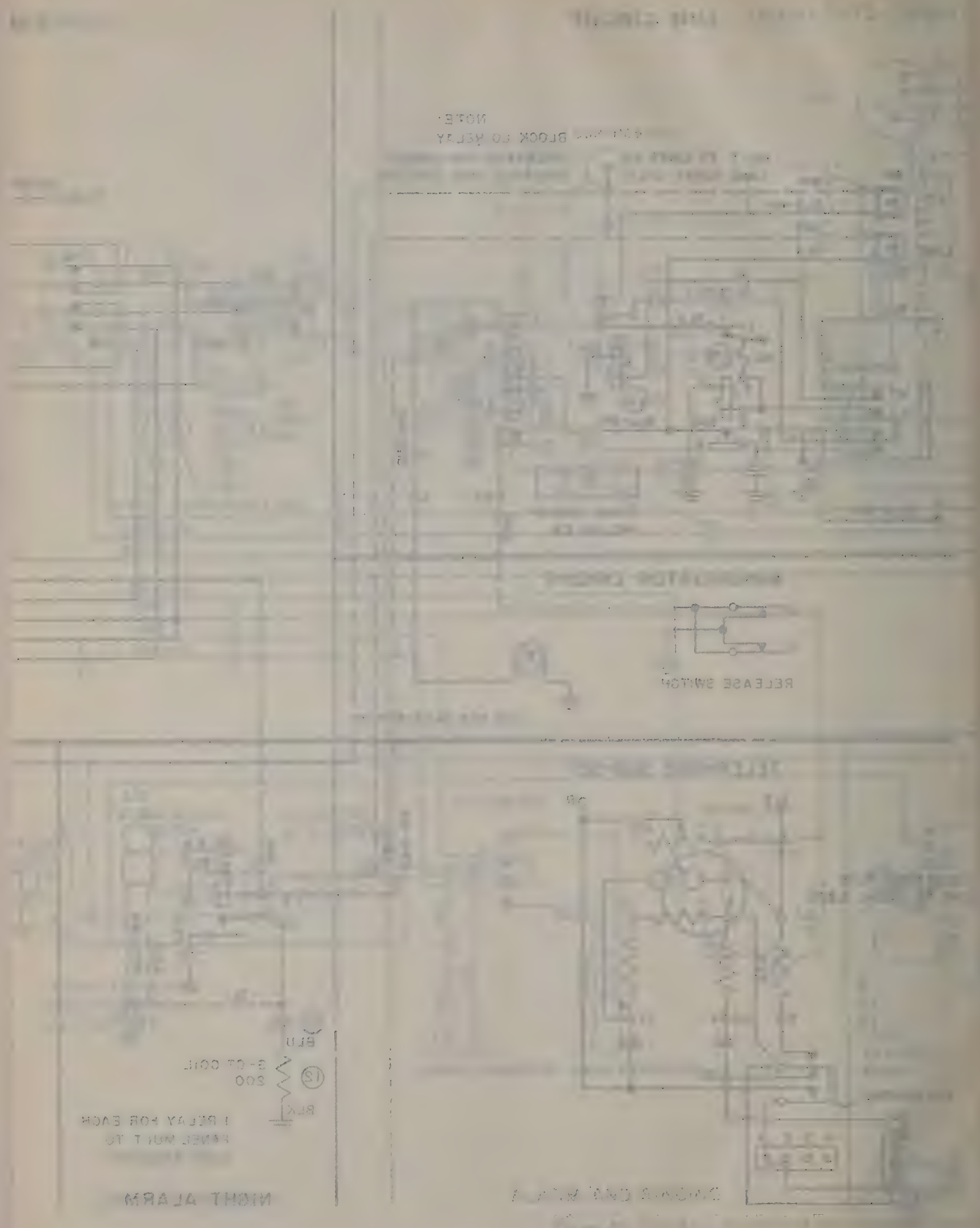


Figure 32. Telephone Switchboard SB-55(*)/FTC, complete schematic diagram

864940°-50 (Face p. 44)



CHAPTER 5

SHIPMENT AND LIMITED STORAGE AND DEMOLITION TO PREVENT ENEMY USE

Section I. SHIPMENT AND STORAGE

NOTE.—See appendix I for references on packaging and packing instructions.

49. Disassembly

The circumstances involved by shipment and storage vary and, therefore, no definite procedure for repacking can be given. The following instructions are recommended as a guide for preparing the switchboard for transportation and storage:

a. Disconnect all power leads and grounds.

b. Disconnect all wire to switchboard.

c. Fasten cover of back of board in place.

50. Repacking for Shipment or Limited Storage

a. The exact procedure in repacking for shipment or limited storage depends upon the material available and the conditions under which the equipment is to be shipped or stored. Refer to paragraph 7*i* of this manual and follow the instructions given in reverse order.

b. Whenever practicable, place a dehydrating agent, such as silica gel, inside the case. Protect the case with a waterproof barrier. Seal the seams of the paper barrier with waterproof sealing compound or tape. Pack the protected case in a padded wooden case, providing at least 3 inches of excelsior padding or some similar material between the paper barrier and the packing case.

Section II. DEMOLITION TO PREVENT ENEMY USE

51. General

The demolition procedures outlined in paragraphs 52 and 53 will be used to prevent the enemy from using or salvaging this equipment. Demolition of the equipment will be accomplished *only* upon order of the commander.

52. Methods of Destruction

a. Smash. Use sledges, axes, handaxes, pickaxes, hammers, crowbars, and heavy tools.

b. Cut. Use axes, handaxes, and machetes.

c. Burn. Use gasoline, kerosene, oil, flame throwers, and incendiary grenades.

d. Explosives. Use firearms, grenades, and TNT.

e. Other. Use anything immediately available for destruction of this equipment.

f. Disposal. Bury in slit trenches, fox holes, and other holes. Throw in streams. Scatter.

53. Destruction of Components

a. Smash (par. 52*a*) the cabinet, platen, lamps, switches, glass, mirror, springs, capacitors, and resistors.

b. Cut (par. 52*b*) all wiring in electrical circuits.

c. Burn (par. 52*c*) all instruction books, circuit diagrams, cords, wiring.

d. Bury or scatter all above pieces after destroying, including handtools.

e. DESTROY EVERYTHING.

APPENDIX I

REFERENCES

NOTE.—For availability of items listed see FM 21–6 and SR 310–20–3.

1. Supply Publications

SB 11–47_____ Instructions for Requisitioning Signal Corps Supplies.
SB 11–76_____ Signal Corps Kit and Materials for Moisture- and Fungi-Resistant Treatment.

2. Technical Manuals on Auxiliary Equipment and Test Equipment

TM 9–2857___ Storage Batteries Lead-Acid Type.
TM 11–430___ Storage Batteries for Signal Communication. Except those pertaining to Aircraft.
TM 11–473___ Central Office Maintenance.
TM 11–2002__ Substitute Telephone Central Office Equipment.
TM 11–2021__ Ringers TA–38/FC and TA–39/FC (Voice-Frequency Ringer Packaged Equipment).
TM 11–4301__ Tactical Switchboards and Long Lines Equipment — Repair Instructions, General Requirements.
TM 11–4302__ Tactical Switchboards and Long Lines Equipment— Repair Instructions, Apparatus Requirements.

3. Painting, Preserving, and Lubrication

TB SIG 13___ Moistureproofing and Fungiproofing Signal Corps Equipment.
TB SIG 69___ Lubrication of Ground Signal Equipment.

4. Camouflage

FM 5–20_____ Camouflage, Basic Principles.

5. Packaging and Packing Instructions

a. JOINT ARMY-NAVY PACKAGING INSTRUCTIONS.
JAN–D–169__ Desiccants, Activated.
JAN–P–100__ General Specifications.
JAN–P–106__ Boxes, Wood, Nailed.
JAN–P–116__ Preservation, Methods of.
JAN–P–125__ Barrier Material, Waterproof.
JAN–P–131__ Barrier Material, Moisture-Vaporproof, Flexible.

b. U. S. ARMY SPECIFICATIONS.
100–2E___ Marking Shipments by Contractors (and Signal Corps Supplement thereto).
100–14A__ Army-Navy General Specification for Packaging and Packing for Overseas Shipment.

c. SIGNAL CORPS INSTRUCTIONS.
720–7_____ Standard Pack.
726–15____ Interior Marking.

6. Decontamination

TM 3–220____ Decontamination.

7. Demolition

FM 5–25_____ Explosives and Demolitions.

8. Other Publications

FM 21–6_____ List and Index of Department of the Army Publications.
FM 21–8_____ Military Training Aids.
TB SIG 66___ Winter Maintenance of Signal Equipment.
TB SIG 72___ Tropical Maintenance of Ground Signal Equipment.
TB SIG 75___ Desert Maintenance of Ground Signal Equipment.
TB SIG 123__ Preventive Maintenance Practices for Ground Signal Equipment.
TM 1–455____ Electrical Fundamentals.
TM 38–650___ Basic Maintenance Manual.

9. Forms

NME Form 6 (Report of Damaged or Improper Shipment).
DA AGO Form 468 (Unsatisfactory Equipment Report).
AF Form 54 (Unsatisfactory Report).

APPENDIX II

IDENTIFICATION TABLE OF PARTS

1. Requisitioning Parts

The fact that an item appears in this manual is not sufficient basis for requisitioning the part. Requisitions must cite an authorized basis, such as T/O&E's, T/A's, TB/A's, SIG 6, SIG 7, SIG 8, SIG 7–8–10, SIG 10, list of expendable material, or another authorized supply basis. The Department of the Army Supply Catalog applicable to the equipment covered in this manual is Organizational Maintenance Allowances and Field and Base Maintenance Stockage Guide, (Including Fixed Plant Maintenance Lists) SIG 7–8–10 SB–55/FTC. For an index of available supply catalogs in the Signal portion of the Department of the Army Supply Catalog see the latest issue of SIG 1, Introduction and Index.

2. Telephone Switchboard SB–55/FTC

Ref symbol	Name of part and description	Function of part	Signal Corps stock No.
	SWITCHBOARD SB–55/FTC, telephone: fixed station; nonmultiple; cap, 100 lines, 2 trunks and 3 cord ckt, full cap equip installed; manual operation; common battery type; 38¼″ lg x 23 15/16″ wd x 57 3/16″ h overall; oak cabinet; floor mtg; fire reporting sb; Sig C dwg ES–S–332, figs. 2, 3, 4, 5, 7, 8, 9, and 11, or Kellogg dwg #416737.	For use as part of a communication system for fire reporting.	4C17050
0318	ADJUSTER, spring: steel, w/black finish; 5¼″ lg x 3/16″ diam overall; single and 90° bend; #21 B&S ga slot; for switch springs; Kellogg part #67.	For adjusting switch springs.	6R40067
0319	ADJUSTER, spring: steel, w/black finish; 6″ lg x 5/16″ wd x ⅛″ thk overall; double ended 15° bends; #23 B&S ga slot; for center springs of relay pile-ups; Kellogg part #60.	For adjusting center springs or relay pile-ups.	6R40060
NA Bell	BELL: vibrating type; nonadjustable tone; 10″ gong; 10″ diam x 4″ d overall; 48 DC; steel; Faraday Electric Corp part #2020–W.	Night alarm audible signal.	4Z408–1
	BOARD, terminal: connects line and sb ckt; 60 solder lug term; hard rubber base; 3⅛″ lg x 2 19/32″ wd x 1⅝″ thk overall; Kellogg dwg #36386, det #11.	For connecting line and switchboard circuits.	3Z770–60
	BOARD, terminal: connects miscellaneous ckt; 10 pr solder lug term; hard rubber base; 3¼″ lg x 1 11/32″ wd x 1½″ thk overall; Kellogg dwg #36386, det #1.	For connecting miscellaneous circuits.	3Z770–20
H–13	BURNISHER, contact: steel, polished finish; 6″ lg x 3/16″ wd x 1/32″ thk; Kellogg part #68.	For cleaning contacts	6R40068
L. O. Alarm	BUZZER, signal: vibrating type; adj pitch; 2 13/16″ diam x 1¼″ h overall; 48 v DC; nonpolarized; 500 ohms; steel housing; Kellogg part #10–C.	Line out audible signal	4Z3048
	CAP: sb lamp; brass shank, nickel pl, glass lens; 1 5/16″ diam x ⅞″ lg overall; white lens; Kellogg part #9.	For ringing power failure lamp.	4C2009
	CAP: sb lamp; brass shank, nickel pl, glass lens; 1 1/16″ diam x ⅞″ lg overall; amber lens; Kellogg part #9–D.	For power and fuse alarm failure lamp.	4C2009D
L. O	CAP: sb lamp; brass shank, glass lens; ⅜″ diam x ½″ lg overall; white lens; Kellogg part #154.	For line out lamps	4C2154

2. Telephone Switchboard SB–55/FTC—Continued

Ref symbol	Name of part and description	Function of part	Signal Corps stock No.
Line, Supv	CAP: sb lamp; brass shank, glass lens; ⅜″ diam x ½″ lg overall; red lens; Kellogg part #154–A.	For line lamps	4C2154A
	CAP: sb lamp; brass shank, glass lens; ⅜″ diam x ½″ lg overall; green lens; Kellogg part #154–W.	For trunk pilot light lamps.	4C2154W
(8)	CAPACITOR, fixed: paper; 1 mf +15% −5%; 200 vdcw; metal case; 3 15/64″ lg x 2 7/32″ wd x 1 13/32″ h; impr; Kellogg part #132.	For trunk circuit	3DB1.132
(T) (R)	CAPACITOR, fixed: paper; 2 mf +15% −5%; metal case; 4⅜″ lg x 1⅛″ wd x 2 1/16″ h; wax impr; Kellogg part #34.	Operates telephone circuit.	3DB2.34
(4), (11)	CAPACITOR, fixed: paper; 2 mf +15% −5%; 160 vdcw; metal case; 3 15/16″ lg x 2 7/32″ wd x 1 13/32″ h; impr; Kellogg part #64.	Operates telephone and night alarm circuit.	3DB2.64
(3)	CAPACITOR, fixed: paper; 2 sect; 2–2 mf +15% −5%; 200 vdcw; metal case; 4″ h x 2⅜″ wd x 1 13/16″ thk; wax impr; Kellogg part #128.	Operates telephone circuit.	3DB2.128
(7)	COIL, relay: single winding; 50 ohms noninductive; 3⅝″ lg x 1″ diam overall; Kellogg part #S–DJ.	For relay circuit	3C1091–10
72A Ind Coil	COIL, telephone induction: 2 windings; 6″ lg x 2″ wd x 1⅝″ h overall; Kellogg part #72–A.	Operates telephone circuit.	3C872A
8C Ret. Coil	COIL, telephone retardation: single winding; 6″ lg x 2″ wd x 1⅞″ h overall; Kellogg part #8–C.	Same as above	3C1608C–1
8D Ret. Coil	COIL, telephone retardation: single winding; 6″ lg x 2″ wd x 1⅞″ h overall; Kellogg part #8–D.	Same as above	3C1608D
(R)	COIL, telephone retardation: 2 windings; 4⅛″ h x 2⅜″ wd x 1¾″ thk overall; mp; Kellogg part #56–B.	Operates cord circuit	3C1608B
	CORD, handset: 4 #30 AWG tinsel cond, color-coded; cotton outer braid; 46″ lg, excluding terminations; four P–12925 spade term on sb end, three P–33566 spade term and one P–67298 ring term on handset end; Kellogg part #F–698–G, Kellogg dwg #53126–G.	Part of telephone	3E7382–46
	CORD, switchboard: 3 #30 AWG tinsel cond, color-coded: glazed cotton overall; braid; 72″ lg, excluding terminations; two #31061 ring term on plug end, three 6″ leads w/#151 spade term and #51535 term on stay cord on sb end; Kellogg part #309–TO.	Answering cords	3E60.7
Dial	DIAL: telephone; brass, w/black E finish; 3″ diam x 1½″ h overall; marked H–74876–8 on back; three shunt springs normally open, two impulse springs normally closed; Auto Elec part #H–74876–8.	For dialing automatic exchanges.	4B796.1
H–14	EXTRACTOR, lamp: fits Kellogg #2448–TD sb lamps; steel, cad pl; 2½″ lg x 5/16″ diam overall; Kellogg part #25.	For extracting switchboard lamps.	6R40025
	FUSE, open link: 2 amp; slotted term for #10 screws; operates in less than 1 min on 3 amp; 1 13/32″ lg x 13/32″ wd x 15/16″ mtg/c; phenol fiber body; WECo part #24–B.	For line protection	3Z2124B2
	GENERATOR, hand ringing: telephone; 5 magnets; 8¼″ lg x 4″ wd x 5½″ h overall; w/handle; Kellogg part #72.	For emergency ringing power supply.	4B904–6
	HANDSET: xmtr impedance, 300 ohms, rec impedance 300 ohms; black phenolic handle; 9½″ lg x 2⅝″ wd x 3⅛″ overall; Kellogg part #F–39–C, Kellogg dwg #43109.	Operates handset	4B1153–3
	JACK ASSEMBLY, telephone: 10 jacks mtd on hard rubber strip; for 3-cond plugs; 11⅛″ lg x 3 3/16″ wd x 7/16″ thk overall; cont arrangement of all jacks, J7–1C; strip numbered 1 to 10; Kellogg part #324.	Line jacks	4C4432.41–1

2. Telephone Switchboard SB–55/FTC—Continued

Ref symbol	Name of part and description	Function of part	Signal Corps stock No.
H–14	JACK ASSEMBLY, telephone: 10 jacks mtd on hard rubber strip; for 3-cond plugs; 11⅛″ lg x 3 3/16″ wd x 7/16″ thk overall; cont arrangement of all jacks, J7–1C; strip numbered 11 to 20; Kellogg part #324.	Same as above	4C4432.4–12
	JACK ASSEMBLY, telephone: 10 jacks mtd on hard rubber strip; for 3-cond plugs; 11⅛″ lg x 3 3/16″ wd x 7/16″ thk overall; cont arrangement of all jacks, J7–1C; strip numbered 21 to 30; Kellogg part #324, Sig C order 11424–Phila–47.	Same as above	4C4432.4–8
	JACK ASSEMBLY, telephone: 10 jacks mtd on hard rubber strip; for 3-cond plugs; 11⅛″ lg x 3 3/16″ wd x 7/16″ thk overall; cont arrangement of all jacks, J7–1C; strip numbered 31 to 40; Kellogg part #324.	Same as above	4C4432.4–9
	JACK ASSEMBLY, telephone: 10 jacks mtd on hard rubber strip; for 3-cond plugs; 11⅛″ lg x 3 3/16″ wd x 7/16″ thk overall; cont arrangement of all jacks, J7–1C; strip numbered 41 to 50; Kellogg part #324, Sig C order 11424–Phila–47.	Same as above	4C4432.4–5
	JACK ASSEMBLY, telephone: 10 jacks mtd on hard rubber strip; for 3-cond plugs; 11⅛″ lg x 3 3/16″ wd x 7/16″ thk overall; cont arrangement of all jacks, J7–1C; strip numbered 51 to 60; Kellogg part #324, Sig C order 11424–Phila–47.	Same as above	4C4432.4–6
	JACK ASSEMBLY, telephone: 10 jacks mtd on hard rubber strip; for 3-cond plugs; 11⅛″ lg x 3 3/16″ wd x 7/16″ thk overall; cont arrangement of all jacks, J7–1C; strip numbered 61 to 70; Kellogg part #324.	Same as above	4C4432.4–2
	JACK ASSEMBLY, telephone: 10 jacks mtd on hard rubber strip; for 3-cond plugs; 11⅛″ lg x 3 3/16″ wd x 7/16″ thk overall; cont arrangement of all jacks, J7–1C; strip numbered 71 to 80; Kellogg part #324.	Same as above	4C4432.4–3
	JACK ASSEMBLY, telephone: 10 jacks mtd on hard rubber strip; for 3-cond plugs; 11⅛″ lg x 3 3/16″ wd x 7/16″ thk overall; cont arrangement of all jacks, J7–1C; strip numbered 81 to 90; Kellogg part #324.	Same as above	4C4432.4–7
	JACK ASSEMBLY, telephone: 10 jacks mtd on hard rubber strip; for 3-cond plugs; 11⅛″ lg x 3 3/16″ wd x 7/16″ thk overall; cont arrangement of all jacks, J7–1C; strip numbered 91 to 100; Kellogg part #324.	Same as above	4C4432.4–4
LO Line Supv	LAMP, incandescent: 48 v 0.035 to 0.045 amp; T–2 clear bulb; 1 1/16″ lg overall; #902 slide base; tungsten filament; Kellogg part #2448–TD.	For line cut and line supervisory circuit.	4C5448TD
	LAMP, incandescent: 120 v 15 w; bulb A–15 inside frosted; 3½″ lg overall; medium screw base; C–9 filament; GE #15A15; Kellogg part #110–A.	For generator circuit ringing resistance.	6Z6820–2.1
	LAMPHOLDER: medium screw base; porcelain body; 250 v, 660 w; 1¾″ h w/2¼″ sq base overall; non-switching, cleat type; Hubbell part #9402.	For incandescent lamp in generator circuit.	6Z7803–1
	LAMPHOLDER: telephone sb lamps; steel frame, rust-proof finish; 2″ lg x 5/16″ wd x ½″ h overall; Kellogg part #39.	For cord, trunk, and generator circuits.	4C4439
	LIGHT ASSEMBLY, indicator: mts 10 Kellogg #34 lamp jacks; brass frame; 11⅛″ lg x ½″ h x 3″ d overall; Kellogg part #34.	For line circuits	4C9733.4
	LOCK: chest lock; lever tumbler; 2 7/16″ lg x 1¾″ wd x ½″ thk overall; steel; w/barrell type key; Corbin Cabinet #80; Engle Lock #583.	For switch shelf	4C5576
	MOUNTING, dial: steel, w/black E finish; 2⅞″ diam x 1¾″ h x 1/16″ thk; Auto Elec #B–78399–A.	For mounting dial	4B1927

2. Telephone Switchboard SB–55/FTC—Continued

Ref symbol	Name of part and description	Function of part	Signal Corps stock No.
H–15	PLIERS: duck-billed type for telephone heat coils; 6″ lg steel; Klein part #313–6.	For telephone heat coils	6R40858
	PLUG, telephone: 3-cond; single shank; tubular, red fiber shell; shank ¼″ diam x 1$^{9}/_{32}$″ lg, shell $^{7}/_{16}$″ diam, 3.336″ lg overall; Kellogg part #106.	For answering cords	4C6706
	POST, binding: solder term one end; #6–32 x ½″ RH mach screw w/washer other end; base 1″ lg x $^{5}/_{16}$″ wd x $^{3}/_{16}$″ thk; mts w/#5 x ½″ lg RH wood screw; brass, nickel finish; burr on base located on wood mtg base; Kellogg part #11.	For connecting batteries to board.	3Z511
	RECEIVER ELEMENT, telephone: aluminum case; 300 ohm impedance; 2¼″ diam x 1″ thk overall; two spring clip term on back of case; Kellogg part #55919.	For handset	4B3052–2
(1)	RELAY, armature: cont arrangement 1B; 250 ma, 48 v; single winding, 48 v DC, operates 0.034 amp, 1000 ohm, ins; 4¼″ lg x 1″ wd x 1⅜″ h overall; fast acting, slow release; impr for tropical use; Kellogg part #D–2030–S–AQ.	Telephone circuit relay	4C8130.4
(LO)	RELAY, armature: cont arrangement 1C; 250 ma, 48 v; single winding, 48 v DC, operates 0.010 amp, releases 0.0025 amp, 70 ohm, ins; 4¼″ lg x 1″ wd x 1⅜″ h overall; fast acting; impr for tropical use; Kellogg part #2102–S–JF.	Cord and line circuit relay.	4C8199.102SFJ
(S)	RELAY, armature: cont arrangement 1C; 250 ma, 48 v; single winding, 48 v DC, operates 0.035 amp, releases 0.014 amp, 35 ohm, ins; 4¼″ lg x 1″ wd x 1⅜″ h overall; fast acting; impr for tropical use; Kellogg part #2102–S–JG.	Cord circuit relay	4C8199.102SJG
(16)	RELAY, armature: cont arrangement 1C; 250 ma, 48 v; single winding, 48 v DC, operates 0.027 amp, 1500 ohm, ins; 4¼″ lg x 1″ wd x 1⅜″ h overall; slow acting; impr for tropical use; Kellogg part #2001–S–X, Sig C order 11424–Phila–47.	Power failure circuit relay.	4C8101.8
(10), (13)	RELAY, armature: cont arrangement 1C; 250 ma, 48 v; single winding, 48 v DC, operates 0.037 amp, releases 0.0015 amp, 3.5 ohm, ins; 4¼″ lg x 1″ wd x 1⅜″ h overall; fast acting; w/arm travel adj screw, arm tension adj screw, and cont tension screw; impr for tropical use; Kellogg part #2102–S–HG.	Line out alarm and night alarm relay.	4C8199.102SHG
(2)	RELAY, armature: cont arrangement 1D2C; 250 ma, 48 v; single winding, 48 v DC, operates 0.034 amp, 1000 ohm, ins; 4¼″ lg x 1″ wd x 1⅜″ h overall; fast acting, slow release; impr for tropical use; Kellogg part #D–2019–S–AQ.	Telephone circuit relay	4C8119
(A)	RELAY, armature: cont arrangement 2A; 250 ma, 48 v; dual winding, 48 v DC, operates 0.034 amp, 1000–1000 ohm, ins; 4¼″ lg x 1″ wd x 1⅜″ h overall; fast acting, impr for tropical use; Kellogg part #2037–T–Y.	Line circuit relay	4C8137.6
(ER)	RELAY, armature: cont arrangement 2A; 250 ma, 48 v; dual wound coil, 48 v DC, operates 0.030 amp, 500–2000 ohm, 2000 ohm noninductive, ins; 3½″ lg x ¾″ wd x 1⅜″ h overall; fast acting; impr for tropical use; Kellogg part #579–D.	Same as above	4C8079D
(5)	RELAY, armature: cont arrangement 2A; 250 ma, 48 v; dual winding, 48 v DC, operates 0.014 amp non-operate 0.009 amp, 1000–310 ohm, ins; 4¼″ lg x 1″ wd x 1⅜″ h overall; fast acting; impr for tropical use; Kellogg part #D–2056–C–FE.	Trunk circuit relay	4C8156

2. Telephone Switchboard SB–55/FTC—Continued

Ref symbol	Name of part and description	Function of part	Signal Corps stock No.
(6), (12)	RESISTOR, fixed: WW; 200 ohm, noninductive; 3⅝″ lg x 1″ diam; impr for tropical use; Kellogg part #S–CT.	Night alarm and trunk circuit relays.	3Z6020–46
(14)	RESISTOR, fixed: WW; 2000 ohm ±5%; 6 w; 4 21/32″ lg x 1 31/64″ wd x ⅜″ thk; WECo part #18BA.	Generator circuit	3Z6200–55
(15)	RESISTOR, fixed: composition; 100,000 ohms ±5%; ½ w; max body dimen 0.655″ lg x 0.249″ diam; JAN type RC21BF104J.	Same as above	3RC21BF104J
Thermistor (9)	RESISTOR, thermal: glass inclosed; 60,000 ohms at zero cur, 450 ohms at max cut of 150 ma; 1⅝″ lg x ⅜″ diam overall; WECo part #1–A.	Trunk circuit	3Z6926–5
H–16	SCRAPER: steel, cad pl; 5¾″ lg x 3/16″ diam; Kellogg part #4.	For cleaning switch springs and contacts.	6R4004
H–17	SCREWDRIVER: 1 13/32″ blade; 5¾″ lg overall; 5/32″ diam shank; 0.040″ wd x 0.023″ thk bit; stained hardwood handle; Kellogg part #22.	For hollow switchboard plug screws.	6R40022
	STRIP: designation; maple w/ebonized finish on front edge; 11⅛″ lg x 2 19/32″ wd x 7/16″ thk overall; complete w/brass cord holder, card, and celluloid cover; Kellogg part #20.	Used on jack field for designation of circuits.	4C9889.20
Normal Talk Hold.	SWITCH, lever: 2-position locking; cont arrangement, position #1–1C and 2C, position #2–1A2D; 250 ma, 48 v; 3⅞″ lg x 1″ wd x ¾″ thk overall; ⅜″ diam x ¾″ lg, hard rubber handle; Kellogg part #ES–3253.	Used in trunk circuit	4C50002.253
Talk Ring	SWITCH, lever: 2 positions; position #1, locking, position #2, nonlocking; cont arrangement, position #1–1A and 2A, position #2–1A2C; 250 ma, 48 v; 3⅞″ lg x 1″ wd x ¾″ thk overall; ⅜″ diam x ¾″ lg, hard rubber handle; Kellogg part #1021.	Used in cord circuit	4C5021
LO Alarm Key	SWITCH, rotary: cont arrangement 2C; 250 ma, 48 v; 2¾″ lg (not incl button) x ½″ diam overall; locking action, normally closed; black rubber button; Kellogg part #2500.	Line out alarm circuit	3Z9551–2
Gen Switch	SWITCH, rotary: cont arrangement 2C; 250 ma, 48 v; 2¾″ lg (not incl button) x ½″ diam overall; locking action, normally closed; red fiber button; Kellogg part #2500 (spcl w/P–66606).	Ringing transfer switch	3Z9551–1
H–18	TOOL, crimping: pliers; lever action; 5″ lg; steel; smooth jaws w/two grooves; Kellogg part #39.	For assembling terminals on tinsel cords.	6R40039
	TRANSMITTER ELEMENT, telephone: aluminum case; 40–55 ohms resistance, 300 impedance; 2 3/16″ diam x 13/16″ thk overall; two springs clip term on back of case; Kellogg part #66521.	For handset	4B9770
	TUBE, electron: JAN–359–A, per JAN–1A	Visual indicator in ringing circuit.	2J359A
3A Suppressor	VARISTOR: 1 5/16″ lg x 1 13/16″ wd x ¾″ h overall; Kellogg #3–A.	Click suppressor in operator's receiving circuit.	4Z7025
	WEIGHT, cord: steel shell filled w/lead; 4″ lg x 1 23/32″ wd x ½″ thk overall; 1 5/16″ diam x 1 1/32″ wd lignm vitae pulley; weight from 9 to 11 oz; Kellogg part #9.	For answering cords	4C29100
H–19	WRENCH: single open end; ⅛″ opening; 2½″ lg x 7/16″ wd x 3/32″ thk; head offset 45°; flat straight handle; Kellogg part #8.	To adjust drop armatures	6R40008
H–20	WRENCH: socket built into wrench; 7/16″ opening; 5¼″ lg, 9/16″ OD socket body; steel, w/black finish; straight; screwdriver handle; Kellogg part #12.	For relay cover nuts	6R40012
H–21	WRENCH: socket built into wrench; ¼″ opening; 4¾″ lg, ⅜″ OD socket body; steel, w/black finish; straight; Kellogg part #11.	For relay armature nuts	6R40011

2. Telephone Switchboard SB–55/FTC—Continued

Ref symbol	Name of part and description	Function of part	Signal Corps stock No.
H–22	WRENCH: socket built into wrench; 3/8" opening; 8" lg, 9/16" OD socket body; steel, w/black finish; straight; screwdriver handle; Kellogg part #13.	For relay mounting nuts	6R40013
H–23	WRENCH: socket built into wrench; 5/16" opening; 18 1/4" lg, 7/16" OD socket body; steel, w/black finish; straight; screwdriver handle; Kellogg part #14.	For jack pin nuts	6R40014
H–24	WRENCH: socket built into wrench; 7/64" opening; 8" lg, 3/16" OD socket body; steel, w/black finish; straight; screwdriver handle; Kellogg part #16.	For stop nuts on No. 1000 cam type switches.	6R40016

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